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CHICAGO EXPOSITION AND CONVENTIONS.

Chicago has been a center of unusual electrical interest for the past two weeks so far as relates to gatherings of electrical men. Last week was an especially strenuous one in this respect. The Electrical Show itself, which proved fully as successful in the matter of attendance, as its predecessor last year, brought out, on the whole, a better average of exhibits. The exhibits were especially strong in illustrating the numerous applications of central station service to every-day life. This is as it should be in an exhibition of this kind, where the object is not only to present things of interest to electrical men, but even more to show the general non-technical public the full range of electrical applications. As far as central station men are concerned, the Chicago Electrical Show of 1907 will go down into history as being notable because of having the first public exhibition of a quantity of American-made tungsten filament incandescent lamps, which type has been much talked about in this country for the past few months, but of which comparatively few central station men have seen actual samples. As to electrical gatherings, there was the Northwestern Electrical Association convention, the rejuvenation of the Sons of Jove and the Electrical Salesmen's convention, to say nothing of the minor meetings.

The Northwestern Association a year ago underwent a great awakening, as noted in these columns at that time, and the result of the past year's efforts of the officers has been very gratifying, both financially and otherwise. An unprecedented number of smaller central station companies applied for membership last week, showing that the movement begun last year to make the association of more practical value to operating central station men has been well directed. The Northwestern convention proceedings of last year contained a great deal on the subject of new business and business getting. The programme of this year, while not containing so much directly on the subject of solicitation and advertising, nevertheless showed a very healthy condition in that subjects pertaining to policies which will build up the more desirable classes of business are prominent on the programme. The paper by Mr. Scott on management showed the importance to the earning capacity of a plant through increasing the kw-hour output for a given kilowatt capacity. The paper by Mr. Honeywell on flat rate sign and display lighting, pointed out one specific way in which this improvement in the load factor could be made, namely, by the securing of flat rate business which remains on until 11 p. m. or midnight. The figures given by Mr. Honeywell as to the actual results accomplished at Lincoln with this class of business, show what an important effect of increasing the output without increasing the maximum demand in the same ratio. Mr. Gonzenbach's talk on the premium system as applied in his company in getting better economy at the power station and in securing new business in a town where new business is very difficult to get, gives valuable suggestions as to policies calculated to make a central station earn more. Of the papers on

purely operating subjects, Mr. Bushnell's was notable because of the specific data it gives from the experience of large operating companies in which, by virtue of the great number of meters tested yearly, much more conclusive results can be obtained than by any small company. The principal papers at this convention will be found abstracted this week and in later issues.

Technical Men in New Business Departments.

The paper by Mr. Sampson on the conduct of a new business department suited to a town of fifty thousand or less, published in abstract in our January 5 issue, while pointing out strongly at the outset that the sale of a central station's product is a commercial rather than a technical problem, nevertheless came around before closing to advocate the employment of young technical graduates as solicitors for central station companies. This opens up an interesting question upon which we know from conversation with many central station men there is considerable difference of opinion. Is it desirable or feasible to select central station solicitors from among technical men or should other considerations come first in picking the raw material which the majority of central stations establishing new business departments must take and work up into an efficient soliciting force? Some central station managers will claim that a technical man is apt to talk above the heads of the possible customers he is trying to reach and that a technical man's training is that of an engineer rather than that of a salesman. A salesman, they contend, should be of the "special pleader" temperament, whereas the engineer is of a judicial temperament weighing carefully both sides of every question and lacking enthusiasm because of his ability to see clearly all sides of a question.

There is undoubtedly some truth in these contentions. On the other hand, those who favor using technical men or men who have been brought up in the operating departments of the central station point to the fact that it is difficult to teach an outside, non-technical man enough details of the central station business to make him a good solicitor in a short time. There is also much in these contentions, for a solicitor who does not understand his product is certainly as bad or worse than the one who thoroughly understands it but lacks enthusiasm. The experience of various central station companies has amply demonstrated that no definite rules can be laid down on this subject. Excellent solicitors have been obtained both from technical and non-technical ranks. Some companies have picked up men who have been good salesmen in other lines and have taught them the necessary technical details. Experience has proved this to be perfectly feasible. Other companies have taken young technical men who seem to have some of the necessary qualifications of salesmen and have made equally good solicitors. In fact, what is required is a combination of technical knowledge of the business and ability as a salesman. Just how much technical knowledge is required depends very much on the class of work the solicitor is going after. In securing large power contracts a great deal of technical knowledge is necessary. In the ordinary run of lighting contracts the necessary technical knowledge can be acquired in a short time. We believe it worth while to call the attention of technical graduates to this rapidly growing department of the central station business as another possible field for them to enter. Every class graduated from a technical school contains some men whose natural abilities do not lie so much in the direction of engineering work as in the commercial application of engineering and for such the increasingly important commercial department of central station work offers good opportunities.

Leakage Reactance of Induction Motors.

In the design of an induction motor a number of factors demand consideration, as affecting the probable cost, behavior and reliability of the machine to be constructed. One of these considerations is the power factor of the machine at various loads. This is an important matter to the central station, which must supply alternating currents for the operation of such motors. The central station does not regard the efficiency of the induction motors on the system as of primary importance. What it regards as of great importance are the strength of the starting current of the motor, how frequently the motor has to be stopped and started in service, and how much wattless current must accompany the working current when the motor is running; or, expressed in another way, the power factor of the motor at different loads. The higher the power factor of the motor, and the lesser the wattless current required in starting or in running, the better is the motor from the central station standpoint. The power factor of the motor depends upon a variety of details. It is, however, intimately connected with two quantities, namely, first, the reluctance of the magnetic circuits of the motor in normal excitation; and second, the leakage of magnetic flux between the primary and secondary windings, whereby a part of the magnetic flux produced by each fails to link usefully with the windings of the other. When the motor is running at synchronous speed, it takes only an exciting current from the mains. The lower the reluctance of the magnetic circuits, the smaller will be the wattless component of the exciting current. The apparent reactance in ohms which the motor offers at synchronism, determines the wattless current of excitation, and may be called the excitation reactance.

When the motor is running under load, the load current possesses a wattless component over and above that due to excitation. This may be attributed to a certain virtual number of ohms of leakage reactance in the motor due to incomplete linkage of the magnetic fluxes produced by the primary and secondary windings, respectively. The ratio of the leakage reactance in ohms to the excitation reactance in ohms is called the "leakage factor" of the machine. It is generally admitted that the leakage factor is equal to a "dispersion factor," which is a constant for each particular machine, multiplied by the ratio of the air-gap, or clearance, to the polar pitch. It is not difficult to estimate the excitation reactance in any usual type of induction motor under design. As soon as the leakage factor is determined, the behavior of the machine at any load can be approximately ascertained by the use of the circle diagram. It is known that the locus of the vector primary current of an induction motor practically coincides with a semi-circle. By drawing this semi-circle to scale, the speed, power, primary and secondary currents and losses, as well as the slip, can be readily found at any or all loads. The only difficult and uncertain quantity is the dispersion factor, which includes the effects of slot magnetic leakage, tooth-tip magnetic leakage, and in the case of wound secondary circuits, belt magnetic leakage as well.

In the article appearing on page 181 of this number, Dr. A. S. McAllister gives some simple formulas for deriving the dispersion factor from the dimensions of any given induction motor. These formulas are based upon tables of data published by Mr. H. M. Hobart for 57 different sizes and types of induction motors. He shows the correctness of the statement by Mr. B. A. Behrend that the dispersion factor usually lies between the numbers 10 and 15, and that it is the product of two numbers, each of which follows a substantially straight line law in relation to simple dimensions of the machine. The advantage of Dr. McAllister's empirical formula for the dispersion factor of an induction motor is that, while based upon experimental determinations of actually constructed machines, it conveys a rational conception of the influence of each important dimension in the machine, such as the radial breadth of the clearance or air-gap. It shows, for example, that beyond a certain point relatively little advantage is secured by reducing the air-gap. The average air-gap of the 57 European induction motors cited and tabulated by Mr. Hobart, works out at one-ninth of one centimeter, or a little more than one millimeter. Dr. McAllister's formula has the advantage of simplicity, although entirely empirical. It would be very desirable to have it checked and reported upon by designers in as many different instances as possible.

HIGH TENSION CABLES.

Our readers will be interested in some high-tension experiments at the Milan Congress, an account of which is printed on page 183. Signor Jona, who is remembered with pleasure by those who attended the congress of 1904, is a past master of cable design and construction, and some remarkable results might reasonably be expected from his handiwork. Certainly an artificial line of cable worked at 150,000 volts is extraordinary enough to call for comment anywhere. The cable used in this instance was prepared according to the scheme of graded dielectrics already familiar in the practice of Signor Jona. The result of this design is to produce a cable which for its exterior diameter has an enormous dielectric strength. In the cable here considered, the total diameter was but a trifle over two inches and the dielectric was only about 0.6 inch, in spite of which the cable stood up to more than 200,000 volts. The fact that the conductor was directly lead-sheathed so as to give it a smooth, cylindrical surface doubtless has much to do with the excellence of the result. The sheathing, of course, increases the cost somewhat, but economizes in dielectric enough to recoup a material part of the expense, and in added factor of safety it fully justifies its existence. For present uses such cable appears to be needlessly excellent, but when the call comes for a general increase of working potentials it is no small thing to have the insulation problem worked out in advance. At even the highest pressures now in use such cable would have an ample factor of safety for underground use.

Fortunately underground working with very high potentials is not necessary in this country, and few companies will find themselves forced into the position of carrying very high voltages on cables. There are cases, however, in which such practice would lead to considerable gain in the matter of substation location. There are numerous cases in which a comparatively small amount of cable would avoid an awkward situation if one could rely upon it. It looks now as if cable manufacture had reached a point where one could install underground wires for moderate distances, even at full transmission pressure without much feeling of insecurity. Of more practical importance at present were the exhibits of high-tension submarine cable for a working voltage of 13,000. In this instance the core was also leaded, and the insulation was rubber-sheathed in gutta-percha and then armored. A most interesting feature was the insulation of the individual armor wires with tarred hemp to keep down the inductance, thus allowing the use of separate cables. A cable like this seems capable of excellent service in case of crossing lakes which must otherwise be avoided, although in most instances it is an open question whether in the long run it would not be better policy to raise the voltage, stick to overhead construction and go around. We can recall very few cases in which the use of cables under water, unless for very much higher voltage than 13,000, would effect any great saving. Of course, in using cables on transmission systems either for underground or underwater work, there is considerable risk incurred at the terminals and extreme precaution have to be taken to avoid the risk of puncture if anything upsets the electrodynamic balance of the system.

The experiments on overhead lines offer less of interest, although they showed beautifully the lessened difficulties from brush discharge as the size of the conductors is increased. It is fortunate that in the very cases demanding extraordinary working pressure the amount of energy to be transmitted is generally great enough to make large conductors a necessity. Yet inductance then becomes serious and everything points to the need of a considerable reduction of frequency in such cases. There are those who insinuate that it would be reduced to zero in attempting the extreme. Altogether working voltage has not been advancing by leaps in recent years, and it is only very recently that the 60,000-volt limit was actually passed in regular commercial work. The limit is now moving up to the neighborhood of 70,000 and perhaps the next few years will see some very material progress. The insulators used in the Milan experiments come pretty near to ranking as architectural structures suggesting pagodas in honor of the gods of potential. Since the endurance of insulators under adverse conditions seems to be quite accurately measured by their dimensions along the line of possible discharge, it seems probable that these very large structures have come to stay, at least until line wires are carried in suspension, and with them comes almost of necessity the very long steel pin and long span construction in one form or another. To provide a suitable factor of safety for a working alternating-current pressure of 100,000 volts, the striking distance along the insulator edges would have to be two feet or more, and the mere matter of mechanically supporting the insulator becomes then extremely troublesome. Such requirements raise a new series of problems in line construction on which many experiments are needed. As these Milan experiments show, the elctrostatic effects at extreme potentials are very formidable, and in how far they will prove practically troublesome remains to be seen. Certain it is that it is a long ways from 60,000 volts to 100,000, very much longer than from 20,000 to 60,000, and there will be needed considerable experience which may come high.

Fifteenth Annual Convention of the Northwestern Electrical Association.

The fifteenth annual convention of the Northwestern Electrical Association was called to order at the convention hall in the Coliseum Annex, Chicago, 11 a. m., January 16. President Harold Almert made a few informal remarks, thus following out the custom of the association of having no formal presidential address. He said that the crest of the wave of municipal ownership sentiment which had been passing over the country seemed to have been reached, and this sentiment is now on the decline. What little agitation there had been recently in the association's territory was mainly in regard to street railways. Not much had been said about lighting companies. Electric lighting companies had been analyzing their conditions more closely the past year and determining the possibilities for business. He thought the result had been more confidence in public service corporation securities and there had been recently better demand for such securities. With the present high prices for construction materials, companies were not planning extensions so much as attempting to develop more fully the territory already occupied. He called attention to one matter which the association should consider, namely, the status of engineers and superintendents of municipal lighting plants in the association. There were some in the association at present. He favored the admission of such members, but on different terms from those connected with private corporations. As to association business matters, the present secretary had declined to accept any salary for his services the past year. As a result of this and good business management, the association was able to end the year with a balance on the right side of the ledger —something which had not occurred for a number of years.

The report of Mr. B. C. Adams, secretary and treasurer, showed that there had been two executive committee meetings during the year, one of which was to consider the resignation of the secretary because of his removal from Madison, Wis., to Lincoln, Neb. This resignation was not accepted. At the other executive committee meeting it was decided to hold the annual meeting in Chicago at the time of the Electrical Show. He then gave a financial report which showed a cash balance of $23.25 and assets $39.96 in excess of liabilities. A nominating committee consisting of Mr. John H. Harding, of La Porte, Ind.; Mr. F. W. Insull, of Evanston, Ill., and Mr. I. P. Lord, of Waupaca, Wis., was appointed. The president announced that active members of the association would receive free tickets to the Illuminating Engineering Society dinner on Thursday evening, the entertainment committee having chosen this means of entertaining the association in place of a theatre party as in years past.

At the Wednesday afternoon session Mr. O. J. Bushnell, superintendent of the meter department of the Chicago Edison Company, presented a paper entitled "Warrantable Expense for Meter Testing." An abstract of this paper and the discussion following it will be given in a subsequent issue.

Mr. J. Robert Crouse, of the Co-operative Electrical Development Association, reviewed the progress of the Association up to date. He read extracts from a report he persented at the December 13 meeting of the association in New York, and told of the action taken at that meeting in appointing committees on membership, subscriptions, commercial programme and rules. The association will be organized with all the functions and powers of a corporation.

After Mr. Crouse's address, Mr. Ernest Gonzenbach read a paper on the water powers of Wisconsin. This paper reviewed the favorable conditions for electrical water power development on a number of Wisconsin rivers, and showed the great undeveloped possibilities in the state. In the discussion which followed this paper, it was shown by Mr. Utley, of Watertown, that companies do not have the power to condemn land for water purposes in Wisconsin. The only water rights given by Wisconsin laws are those allowing the development of streams for logging purposes. It is necessary to have a slight change in the Wisconsin laws before extensive water power development can be expected. Members of the association were urged to stand together in securing the passage of such laws.

At the opening of the morning session of Thursday Mr. F. W. Insull, of Evanston, Ill., read a paper on "Uniform Systems of Accounting for Small Companies." He stated that the object of a system of accounts was to obtain exact information as to the amount of money invested and the results obtained therefrom. It is not sufficient that simply the total results be known, but closer analysis must be made to know what proportion each item is of the whole. Agitation for reduction of rates is the result of ignorance on the part of the general public as to costs. The trouble was that in most cases the companies themselves did not know what the different classes of service were costing them. Companies must be in a position to show the public or anyone else what different classes of service cost. It is not enough to argue the case; arguments must be backed up with facts and figures. He then went into a description of a classification recommended, which does not permit of abstract here.

After a short discussion of Mr. Insull's paper, Mr. H. H. Scott, of New York, formerly of Madison, Wis., read a paper entitled, "Some Phases of Smaller Central Station Management," which was discussed at length. This discussion was followed by the reading of a paper written by Mr. Homer Honeywell, of Lincoln, Neb., entitled, "Outline Lighting," which also elicited a good discussion. A discussion on producer gas power was started by President Harold Almert, who read extracts from a report on this subject which he recently had occasion to make. Mr. Thomas B. Whitted, of the St. Louis office of the Westinghouse Machine Company, also spoke at length on the present status of the gas engine. After this discussion, the convention adjourned until afternoon.

The first paper of the Thursday afternoon session was presented by Mr. C. W. Bergenthal, of the Wagner Electric Manufacturing Company, the title being "Some Characteristics of Alternating-Current Motors in Which the Central Station Man is Vitally Interested." After discussion of this paper, Mr. J. R. Cravath read a short paper on "Some Points in Illuminating Engineering for the Small Central Station," which was also fully discussed.

In the evening a joint meeting of the Northwestern Electrical Association and the Illuminating Engineering Society, Chicago Section, was held in the restaurant in the basement of the Coliseum, dinner being served at 6:30 and discussion immediately following. At this meeting there was a general discussion of street lighting, a report of which will be found elsewhere.

At the beginning of the Friday morning session applications for membership were received from 18 persons, most of them operating central station men from small plants, thus showing a very healthy state of association affairs. Mr. Ernest Gonzenbach, general manager of the Sheboygan Light, Power & Railway Company, gave an informal talk on the plans he had adopted at Sheboygan for giving premiums to employees for power station economy and obtaining new business. This talk and the discussion following brought out many practical points of value. Mr. A. Bement read a short paper on "The Trend of Improvement in the Design and Operation of Boiler Plants," which was followed by a discussion most of which related to the question of flue gas analysis apparatus. After this, the report of the nominating committee was heard, and the following officers were elected for the ensuing year: President, Mr. Edward Daniell, of Marinette, Wis., and Menominee, Mich.; vice-president, Mr. B. C. Adams, of Lincoln, Neb.; second vice-president, Mr. H. F. Pearce, of Negaunee, Mich.; secretary and treasurer, Mr. Roger N. Kimball, of Kenosha, Wis. Directors: Messrs. John S. Allen, of Lake Geneva, Wis.; W. R. Putnam, of Red Wing, Minn.; George H. Lukes, of Chicago. A motion of thanks to the officers for their efficient services during the past year was unanimously carried and Mr. B. C. Adams, the retiring secretary who had declined to accept the $500 annual salary to which, under the rules of the association, he is entitled, was given a special vote of appreciation and the

officers were instructed to have prepared and presented to him a special, appropriately bound copy of the *Transactions* of the convention for 1907. It was voted to hold the next meeting at Milwaukee in January, 1908. If the Chicago Electrical Show is in progress during the week specified in the constitution for the holding of the annual meeting, it is probable that a two days' convention will be held in Milwaukee and that on the third day those desiring will make a trip to Chicago by special car or otherwise to visit the Electrical Show.

Joint Meeting of Chicago Section Illuminating Engineering Society and the Northwestern Electrical Association.

On Thursday evening, January 17, the Chicago Section of the Illuminating Engineering Society held a dinner and meeting jointly with the Northwestern Electrical Association. The dinner was served in the restaurant of the Coliseum at the Electrical Show at 6 p. m. The subject discussed after dinner was street lighting, the following questions being announced as a basis for discussion:

1. "Large versus Small Units in Street Lighting." 2. "Globes and Reflectors for Street Lamps." 3. "New Street Lamps."

Mr. Albert Scheible, leading the discussion, stated the primary objects of street lighting as pathfinding and crime preventing. For pathfinding absence of strong contracts in illumination were necessary as well as the avoidance of shadows. To prevent crime a lamp should be placed opposite each alley entrance, which practically necessitated the use of small units. He exhibited a photometric curve taken from a German publication as being an ideal form of photometric curve for a street lamp. This curve had a form very similar to a sectional view of the blades of a revolving fan.

Mr. W. D'A. Ryan cited the paper he read before the Ohio Electric Light Association in 1901, in which he favored what was at that time a relatively small arc lamp unit. It was a mistake, however, to push the arc below 4 amperes because with such small current the variation in light due to the wandering of arc from one side to the other is too great. For example, 25 degrees below the horizontal in a certain enclosed arc lamp with the arc on one side of the carbons, the candle-power would be 600 on one side and 200 on the opposite side. He gave figures showing the greater candle-power given by a magnetite arc at the useful angles as compared with the ordinary enclosed carbon arc. The magnetite arc with its reflector has very nearly an ideal form of distribution for street lighting. He did not think it wise to use an incandescent lamp of less than 50-cp for street lighting.

Mr. Frank McMaster said that reliable measurements on street illumination were extremely rare. Such measurements were the hardest things ever attempted by engineers. After all was said and done, it was the effect on the eye that determined the efficiency of any system of street illumination. With big lighting units the pupil of the eye is contracted when facing the lamp so that the apparent illumination is considerably cut down, whereas with small units one can see with comfort the length of the street. Physiological effect was therefore of more importance than foot candles. In most of the larger cities where efforts had been made by business men to better light the down-town streets this improved artistic lighting was being done by incandescent lamps.

Mr. R. W. Bingham, speaking on gas mantle burners for street lighting, gave a spacing of one 50-cp gas mantle burner every half block as good lighting for residence streets. Four thousand such lamps are used in the residence streets of New York. They give the advantages of a small unit without unsightly poles or wires. Their maximum candle-power is in a direction which suits them to street lighting whereas with the Nernst lamp the distribution is mainly downward. Mr. McMaster called attention to the fact that the most recent form of Nernst street lamp has a vertical glower which gives a maximum candle-power a little below the horizontal, as is desirable. Mr. W. E. Daniels considered large electric lighting units necessary where wires had to be placed underground; otherwise the cost of ornamental posts for small units would be prohibitive. Lamp posts suited for use on such streets cost from $75 to $100 a post. The street appears better in the daytime with few posts than with many. Mr. F. W. Willcox thought the tendency to be more and more toward incandescent lamps and small lighting units.

Mr. John S. Allen, of Lake Geneva, Wis., spoke of a small town which had recently contracted for and installed an incandescent lighting system with a 32-cp lamp on each corner. These lamps were placed in multiple on street lighting secondaries fed by small transformers, and it was surprising how few transformers were necessary to cover the town. Mr. A. J. Marshall spoke of the lighting of downtown streets with clusters of incandescent lamps placed in spherical globes on ornamental posts as practiced in certain cities. He condemned the use of lamp clusters inside of a single globe in this way because large high efficiency lamps would involve less expense for operation and installation. He favored a dense opal globe for use on such posts.

Mr. J. R. Cravath said that in his opinion the question of large versus small units is largely one of the total amount of light to be used on a street. Where large units were placed at frequent intervals as on down-town streets, their blinding effect was not objectionable because of the large total amount of light on the street surface. However, with an arc lamp on every second corner as in many residence districts, the blinding effect of the lamp absolutely defeated good illumination. Small units were necessary where but a small amount of light was to be used per mile of street.

Mr. Ryan agreed with the statement that it is effect fully as much as foot candle intensity on the street that we are after; otherwise the enclosed arc with its efficiency 50 per cent lower than the old open arc would never have been able to drive out the open arc. The enclosed arc with opal inner globe gave less decided contrasts and produced less blinding effect as well as giving greater candle-power at the most useful angles a little below horizontal.

Mr. F. W. Willcox being asked to discuss the tungsten lamp as applied to series incandescent street lighting said that the tungsten lamp was soon to be put on the market at 1.25 watts per candle consumption for 110 volts. It would be much easier to make short thick filaments of tungsten for series lamps than for multiple lamps, and therefore a very efficient and durable street series lamp for tungsten could be expected. Central station men would then be able to replace old carbon filament lamps with tungsten lamps of the same candle-power and operate three circuits from one transformer where before they had operated one. The efficiency of the tungsten lamp is higher than any other illuminant except the flaming arc.

Officers for the Chicago Section for 1906 were elected in accordance with the new constitution of the Society. The officers elected were as follows: Chairman, Mr. George C. Keech, of the Cooper-Hewitt Lamp Company; secretary, J. R. Cravath, 1139 Monadnock Block. Managers, Messrs. H. V. von Holst, architect, and E. W. Lloyd, contract agent, Chicago Edison Company. Examining Board for new members: Messrs. W. R. Bonham, of the Sawyer-Man Company, and C. E. Ummach, secretary, R. Williamson & Company.

Illuminating Engineering in Boston.

The Boston section of the Illuminating Engineering Society met at the American House, Boston, on January 15 with President Campbell in the chair. Mr. Cowles, of the Edison Electric Illuminating Company, made an address on "The Progress of Electrical Illumination," during which he gave a brief history of the early arc lamps, beginning with the Brush apparatus, and coming down through the carbon filament incandescents to the metal filament lamps and high-efficiency arcs. He

pointed out the attractive features of the tantalum and tungsten lamps and discussed the mercury lamp and the Moore vacuum tube.

Mr. Cowles was followed by Mr. J. S. Codman, whose subject was "Aids to Progress in Lighting." He rehearsed the difficulties that beset an illuminating engineer, say six or seven years ago, he being obliged to do his work without any assistance such as he now receives in the shape of distribution curves which are now published in technical papers, etc., and calculation tables, which save a vast amount of figuring in working out problems of lighting.

At the close of these talks a general discussion followed, participated in by Prof. Adams, Dr. Bell and Messrs. Campbell, Gifford, Clark, Hale, King and others, in which the osmium, the helion and other lamps were commented upon. Forty members were present.

Meeting of Independent Telephonists.

A joint session of the officers and executive committee of the International Independent Telephone Association and representatives of large telephone operating interests was held recently in the office of J. E. Hoge, president of the organization, at Cleveland, Ohio. The proceedings were in the form of a discussion of the points of interest involved in different sections of the country. President Hoge presided at the meeting and J. A. Harney, assistant secretary of the association, and in charge of the headquarters in Cleveland, acted as secretary. The following were present: E. L. Barber, vice-president and general manager of the Independent Telephone Company, of Chicago; M. B. Overly, of Louisville, Ky., representing Southern interests; W. B. Woodbury, general manager of the Home Telephone Company, of Detroit; Charles E. Sumner, of Portland, Oregon, representing the independent interests of the Northwest; J. G. Splane and Robert C. Hall, president and treasurer, respectively, of the Pittsburg & Allegheny Telephone Company, Pittsburg; Senator C. W. Kline, Hazelton. Pa., representing Pennsylvania and New Jersey; Chas S Norton, of Indianapolis, representing the Indianapolis Telephone Co. and the New Long-Distance Telephone Co., which controls extensive toll lines in Indiana; James S. Brailey, Jr., president of the United States and Cuyahoga Telephone companies of Cleveland, and head of the Ohio syndicate; C. Y. McVey, general manager of the United States and Cuyahoga Telephone companies; E. W. Moore, of the Everett-Moore and Ohio Telephone syndicates; J. B. Hoge, president of the International Association, and J. A. Harney, assistant secretary of the same organization.

As to the object of a meeting at this time, President Hoge said: "The last meeting of the executive committee was held in Chicago in October, and since that time important franchises have been granted the independent people in various parts of the country, notably at Omaha, Denver, Milwaukee, and Boston. All of these places have seen a determined fight on the part of the Bell Company to keep the independents out of the field. At Denver and Omaha the matter was submitted to a popular vote at the last election, the results being overwhelmingly in favor of the independent companies. The independent victory at Boston is especially important, Boston being the home of the Bell Telephone Company. An important feature of the independent development during the past few months has been the completion of arrangements to provide full facilities at Chicago and Detroit for connections with the independent lines. The provincial government of Manitoba, Canada, at the last election, was sustained in its policy to establish telephone systems to compete with the Bell Company in Canada, the service, rates and treatment of that company being altogether unsatisfactory to the people of that province. The Manitoba government will at once begin the construction of telephone plants which will connect with the independent lines in the United States. The great progress of the independent movement recently has made it advisable to call this meeting of the association officers and large operating interests to consider plans for carrying on the association work along broader lines. Arrangements have been made to provide sufficient additional funds for that purpose, and a great deal of new work will be undertaken by the association in the near future. The time and place for the next convention was also considered. While no definite decision has been reached, this will probably be held in Chicago early in June."

The public generally has the idea that the independent interests of the country are being formed into one great company or merger, but this seems to be a mistake common to those who do not take pains to get at the bottom of matters. On this point Mr. Hoge had the following to say: "Even if such a merger were possible we would not consider it advisable. Our aim is to keep the independent interests together in a compact organization for mutual advancement. Consolidations are constantly being made here and there throughout the states with a view to greater economy and efficiency, but beyond a certain limit such consolidations are not practicable. The telephone business is peculiar; local control and management are essential to obtain the best results; that and local ownership of securities have been the chief sources of strength of the independent companies. Our present organization includes all of the independent companies in the United States through their state associations, and the independents of Canada through the Canadian Independent Telephone Association. At present there are over 7,000 independent companies in the United States, operating in approximately 13,000 cities and towns, with about 3,500,000 telephones connected with their systems. There is approximately $350,000,000 invested in these properties. The movement in Canada is of comparatively recent growth, but already there are in the neighborhood of 15,000 independent 'phones, a growth of over 100 per cent during the past year, and next year will show a growth of over 200 per cent. Naturally we are gratified by the progress we have made in the last few months. It has exceeded the expectations of the most optimistic independents. Independent telephony has been given a wonderful stimulus by recent victories. More money is being put into the telephone business to-day, and the field is being developed to a greater extent than at any time in the past. The independents now have plants or are building in every important city in the west except Cincinnati, and that city cannot long resist the public demand for independent connections. Plans are in operation or rights have been secured in every important eastern city except Providence, New York and Washington. In the two former the matter of independent franchise is now being agitated, and prospects are bright for independent success despite the strenuous opposition of the Bell at both places. Altogether, the independent telephone situation was never in such good shape as at present. We made wonderful progress during 1906, and start 1907 with prospects for still greater success."

Speaking of the Michigan situation, W. E. Woodbury, general manager of the Home Telephone Company of Detroit, said: "You may say the Detroit proposition is coming along nicely. We have been actively at work for the past six months, and have at present four steel buildings in course of construction, representing an investment, including real estate, of over $250,000. Half our local pole lines in Detroit are up, and about one-third of our subway is completed. We are now at work stringing wire on our completed pole lines. The total investment in the city of Detroit will exceed $3,000,000. In addition to the local work, our company is building 300 miles of toll lines, carrying about 4,000 miles of circuit. This long-distance work represents an investment of over $1,000,000. We will connect with all the independent plants in Michigan, Indiana and Ohio, and through arrangements with the United States Telephone Company will have special facilities for the Cleveland business. At present we have over 9,100 first-class contracts signed up for service, and will begin operations the latter part of this year with 15,000 subscribers. I might add that our property is fully financed, every cent required being at our immediate disposal."

Purdue Meeting of the Institute.

The meeting of the Purdue Branch of the American Institution of Electrical Engineers, held in the new lecture room of the Electrical Building at Purdue University on Tuesday, January 15, was addressed by Professor C. P. Matthews, director of the School of Electrical Engineering. Preceding a discussion of Dr. C. H. Sharp's paper on "New Types of Incandescent Lamps," Professor Matthews gave some interesting facts on the development of the carbon filament lamp, together with the requisites an electric lamp should possess if it is to fill the requirements as it should.

Among the desiderata of the electric lamp brought out and discussed were: Low specific power consumption, good light distribution, good quality of light, long life, sustained candlepower. The individual units should have suitable intensity—that is, should not be of too high or too low a candle-power; should work equally well on either direct-current or alternating-current circuits, and should be capable of rugged construction. The different types of lamps, including the old and the new were then taken up and the points of merit as well as the points that invited improvement of each were brought out.

Interest in the meeting seems to be steadily on the increase as shown by the increased average attendance and membership of this year over preceding years.

Exposition of Safety Appliances.

Under the auspices of the American Institute of Social Service, an exposition of safety appliances and industrial hygiene will be held in the American Museum of Natural History, Central Park West, New York City, January 29 to February 12, open from 10 a.m. to 10 p.m. daily. Admission and exhibit space will both be free and it is believed that as in Europe the exhibit will be attended with great benefit. It will be preceded by a dinner on Monday, January 28, at the Waldorf-Astoria, which Governor Hughes will attend as a guest and speaker. Considerable interest is being manifested in the subject by the public, and it is expected that a permanent Museum of Safety Devices may result, where all the problems of safeguarding life and limb may be studied in their working detail.

The exhibits will embrace devices for safeguarding the lives and limbs of workmen and preventing accidents under the ordinary conditions of life and labor to which the general public is exposed. The exposition will consist as much as possible of "live exhibits," that is machines or devices in operation; models of actual or reduced size, and photographs. Wood and metal-working machinery; stamping, grinding and polishing machines; presses, textiles, the building trades, safeguarded elevators, windlasses, cranes and hoisting machinery; transportation security by sea and land, safety lamps and explosives, quarrying, agricultural and chemical industries; safety from fire.

The section of industrial hygiene will include improved dwellings, first aid to the injured, prevention of tuberculosis and other dread diseases harmful to the life of workmen; respirators and devices for supplying and maintaining pure air and industrial betterment.

Wisconsin Electrical Contractors' Meeting.

The annual winter convention of the Association of Electrical Contractors of Wisconsin was held in Milwaukee on January 15 and 16. Representatives from all of the principal contracting companies in Wisconsin were in attendance. After the transaction of routine business, and the discussion of subjects of mutual interest, officers for the ensuing year were elected, the following gentlemen being selected for the officers named: President, W. F. Meter, of Oshkosh; vice-president, W. G. Pauli, of Racine; secretary, Albert Peterman, of Milwaukee; treasurer, George Knoerr, of Milwaukee. Directors—J. D. Warden, of Oshkosh; A. C. Langstadt, of Appleton, and A. R. Schmidt and G. F. Rohn, both of Milwaukee. The delegates chosen to represent the Wisconsin Association at the annual convention of Electrical Contractors, which is to be held in New York City next July, are W. F. Briggs, of Fond du Lac, and Chris Sarau, of Oshkosh; alternates, A. C. Langstadt, of Milwaukee, and W. G. Pauli, of Racine.

It was decided to make the next summer convention of the association partake of the nature of an outing, the place of meeting selected being a chartered steamer, which will take the delegates on an excursion up the Fox Rixer, in Wisconsin. On the evening of the first day of the convention the delegates banqueted at the Hotel Blatz. Following adjournment on Wednesday, January 16, the association visited the works of the Allis-Chalmers Company, the Cutler-Hammer Manufacturing Company and a number of other large plants, devoted in part, or exclusively, to the manufacture of electrical appliances. Mr. V. B. Burgess, of the Burgess Electric Company, of Duluth, attended the convention as a delegate of the Electrical Contractors' Association of Minnesota.

Electric Traction on the Erie.

The first official trip over the electrified division of the Erie Railroad between Avon and Rochester was made Tuesday, January 22. The distance is 19 miles and the run was made by the motor car in 39 minutes. On the return trip the private car of Superintendent Graham was attached to the motor car when a speed of 35 miles per hour was attained, an excellent showing, considering the physical condition of the new line and apparatus. This is the first 11,000-volt line to be operated in the United States. It will include besides the main line of the Erie Railroad before mentioned, between Rochester and Avon, the branch between Avon and Mt. Morris, making a total of 34 miles of single track besides sidings. Electrical energy is received at 60,000 volts from Niagara Falls. It is expected that by February 15 the line will be ready to be put into permanent operation by electricity. The party that made the trip included Messrs. O. S. Lyford, Jr., W. N. Smith, William McClellan, E. J. Griffith and H. H. Esselsteyn, of Westinghouse, Church, Kerr & Company; and J. M. Graham, vice-president of the Erie Railroad; R. H. Bowron, division superintendent of the Erie Railroad; J. H. Maddy, special representative of the Erie Railroad; J. C. Tucker, superintendent of the Rochester Division; G. W. Dowe, recently superintendent of the Rochester Division; James Burke, engineer maintenance of way; L. B. Stillwell and B. J. Arnold, members of the Electrical Commission of the Erie Railroad.

Foreign Trade Convention.

A convention was held last week in Washington at which the foreign trade of the United States formed the subject of discussion. The attendance on the convention was representative of almost all of the national manufacturing and commercial bodies of the United States, and more than 900 delegates were in attendance. Mr. W. J. Clark, of the General Electric Company, was present as a delegate by appointment of Governor Hughes, and the American Institute of Electrical Engineers was represented by Mr. W. J. Johnston. On Tuesday Secretary Root delivered an address, the keynote of which was the advocacy of maximum and minimum tariff rates. He also asked the convention to endorse the ship subsidy bill now before Congress. At a banquet given after the close of the convention on Wednesday evening, President Roosevelt delivered an address. Among the points upon which he dwelt were the San Domingo question, the betterment of the consular service, the furtherance of trade relations with South America, the Orient and Australia, and the fair treatment to foreign nations on the basis of the Monroe Doctrine. He also advocated the ship sub-

sidy bill now before Congress, and spoke of the necessity of a strong navy in order to avert war. Among others who addressed the convention were Speaker Cannon, Governors Warfield, of Maryland, and Swanson, of Virginia. Mr. E. S. A. de Lima, of the New York Board of Trade and Transportation; Mr. James W. Cleaves, president National Association of Manufacturers; Secretary Oscar S. Straus, of the Department of Commerce and Labor; Hon. John Barrett, Director of the International Bureau of American Republics; Mr. Lewis Nixon, of New York, and Mr. Alvin J. Sanders, of the American Reciprocal Tariff League.

There were heated discussions in the convention on the subject of tariff revision and ship subsidies. A resolution to endorse the subsidy bill now before Congress was passed as amended to represent the views of conservative members, and a resolution was adopted asking for a law providing uniform bills of lading with foreign countries. Action was also taken looking toward permanent organization and the holding of regular conventions like the one just closed.

CURRENT NEWS AND NOTES.

RENASCENT RUSSIA.—Mr. Nicholas Kouznetzoff, of 36 Liteinaia, St. Petersburg, Russia, informs us that a new technical journal called *The Motor* is to be issued twice monthly. It will apparently be devoted principally to automobiles, but will deal incidentally with electricity.

GAS PHOTOMETRY.—On Friday, February 8, 1907, a meeting of the New York section of the Illuminating Engineering Society will be held at the Edison Auditorium, 44 West Twenty-sixth Street, New York, for the election of officers of the New York section for the ensuing year. Mr. Thomas J. Litle, Jr., of the Welsbach Company, will present a paper on "The Photometry of Incandescent Gas Lamps."

PUBLIC UTILITIES ASSOCIATION OF INDIANA.—A meeting of the executive committee of the recently formed Public Utilities Association of Indiana was held at the English Hotel at Indianapolis, Monday, January 14. Headquarters have been opened at 276 and 277 English Hotel, Indianapolis, where some member of the executive committee will keep open house to all electric light men of the State and will be in a position to furnish information regarding any proposed legislation up before the Indiana Legislature. The committee at its meeting decided to make an active campaign to extend the membership of the association.

OHIO STATE CAPITOL.—Adjutant-General Critchfield has announced the determination of the committee on State House lighting to rewire the State House completely. The high-tension wires will be placed in conduits and the telegraph, telephone and messenger companies have been notified that they will be expected to put their lines in good condition at the same time that the more extensive work is done. Recently one of the engineers of the National Board of Fire Underwriters made an examination of the wiring and pronounced much of it worthless. He also stated that the building was in grave danger from fire all the time. This decided the committee to go into the matter more thoroughly than ever before, and the conclusions reached were for a complete overhauling of all the wiring systems.

NEW JERSEY ELECTRICAL CONTRACTORS.—The Electrical Contractors' Association of New Jersey held its annual meeting in Newark, N. J., January 15. The election of officers resulted as follows: President, Philip N. Thorpe, of Paterson; vice-president, George Cook, of Newark; secretary, Charles Adams, of Trenton, and treasurer and State director, Paul H. Jaehnig, of Newark. The board of directors consists of Harry R. Jackson, J. F. Barnhouse and Harry Venino, of Newark; Ralph Salter, of Maplewood, and R. B. Anderson, of Passaic. Addresses were made by Mr. Morton, Mr. Thorpe and Mr. Jaehnig. The meeting was followed by a banquet, at which Philip M. Thorpe acted as toastmaster. "The Welfare of the State and National Associations" was responded to by W. H. Morton, secretary of the National Association.

INTERCHANGE OF TRAFFIC.—A special telegram from Chicago of January 19 says: "The steam railroads in the territory of the Central Passenger Association have decided to discontinue their boycott against their electric competitors. As a result of a conference with D. G. Edwards, vice-president of the Consolidated Electric Railways of Indiana and Ohio, having about 1,200 miles of track, the passenger officials of the steam roads have decided to abrogate their agreement not to interchange traffic with electric lines. The electric lines had agreed to notify the Interstate Commerce Commission of the boycott declared against them by the steam roads and ask that body to enforce that section of the act to regulate commerce which requires all carriers to interchange traffic. The prompt change of front by the steam roads has rendered it unnecessary for the electric lines to appeal to the commission or to the courts."

NIAGARA POWER APPLICATIONS.—It is announced from Washington that Secretary Taft has rendered his decision upon the applications under the Burton act for the issuance of permits to divert water for power from the Niagara Falls on the American side and to transmit electrical energy developed from water power on the Canadian side into the United States. The Secretary decides that with a diversion of 15,600 cu. ft. per min. on the American side and the transmission of 160,000 hp from the Canadian side the scenic grandeur of the falls will not be affected substantially or perceptibly to the eye. On the American side the Niagara Falls Hydraulic & Manufacturing Company will receive a permit for the diversion of 6,500 cu ft. per min. The water for the Erie Canal is to be used under a special permit limiting the consumption to not more than 400 cu. ft., with provision that it shall not confer any right upon the consumer of the water to take it from the canal without authority and subject to the conditions imposed by the canal authorities. Relative to the transmission of electric power from Canada the Secretary decides to issue permits for the importation of such power in the following amounts: The International Railway Company, 1,500 hp; the Ontario Power Company, 60,000 hp; the Canadian Niagara Falls Power Company, 52,500 hp, and the Electrical Development Company, 46,000 hp.

BEAUTY OF NIAGARA.—Secretary Taft will appoint a committee, consisting of Charles F. McKim, the architect; Frederick L. Olmstead, Jr., of Boston, landscape gardener, and Frank D. Millett, the artist, to go to Niagara and gather material for a report looking toward harmonizing the commercial buildings there, particularly the power plants, with the natural beauties. On this subject Mr. Taft says: "I conceive it to be within my power to impose conditions upon the granting of these permits, compliance with which will remedy the unsightly appearance that is given the American side of the canon just below the falls, where the tunnel of the Niagara Falls Power Company discharges and where the works of the Hydraulic Company are placed. The representative of the American Civic Association has properly described the effect upon the sightseer of the view toward the canon to be that of looking into a backyard of a house negligently kept. For the purpose of aiding me in determining what ought to be done to remove this eyesore, including the appearance of the buildings at the top, I shall appoint a committee to advise me what changes, at an expense not out of proportion to the extent of the investment, can be made which will put the side of the canon at this point from bottom to top in natural harmony with the falls and the other surroundings and will conceal as far as possible the raw commercial aspect of the surroundings."

NATIONAL ASSOCIATION OF MANUFACTURERS.—The National Association of Manufacturers has issued a pamphlet explaining to the public what it tries to be and is. Various details are given as to its general work, membership, policies, news service in Washington, advice in legal matters and other details. The secretary of this admirable body is Marshall Cushing and the headquarters are at 170 Broadway, New York City.

WIRELESS IN ITALY.—It is announced from Rome that the Italian Minister of Posts and Telegraphs has decided to establish six wireless stations in Rome, Milan, Turin, Sicily, Sardinia and Massowa for the use of the public at an estimated expenditure of $36,000. The installation will be hastened, as next year the free concession of all of Marconi's patents granted to the Government expires. It is hoped that before then Italy will adopt the wireless system for all inland communications, thus demonstrating the practical utility of Marconi's invention.

NEW ENGLAND INSURANCE EXCHANGE.—At the annual meeting of this exchange, the retiring president in the course of his remarks said: "In our recommendations we emphasized the value of municipal electrical inspectors, who should be free from political influence, competent and supported by local ordinances giving them necessary authority. We believe that this should be the avowed policy of the exchange, as the electrical hazard can be controlled otherwise only at great expense. Reductions have been allowed already at several points for compliance with our recommendation."

EATING LEAD PIPE.—A special telegram from Chicago of January 18 says: "Electrical engineers and fire underwriters interested in the Union Stock Yards have become alarmed over the advent of unidentified larvæ which are swarming in certain sections of the packing plants and insisting upon feeding on the lead pipe insulation of electric wires. These brown, hairy little wigglers, each five-eighths of an inch long, are moving through the "hoof" houses at the yards, gnawing irregular patches of lead, and often cutting through the cloth and rubber insulation and short-circuiting the electric current. Holes an inch long and half an inch wide have been cut through one-tenth inch thickness of lead pipe. 'The lead pipe cinch' bug is the designation given the creature by Director Skiff, of the Field Columbian Museum, in whose entomological laboratory this little lead eater is under observation."

WATER STORAGE AND SUPPLY.—The Forestry, Water Storage and Manufacturing Association of New York State is attempting to secure the passage of an amendment to the State law with respect to water storage. This amendment aims to secure the equalization of the flow of creeks and rivers by storing the water at the time of flood for use during the dry season. It is argued that the building of reservoirs for water storage will confer considerable benefit. First, as to sanitary water supply for many cities and towns; secondly, the enlargement and development of the State canal system; thirdly, in checking destructive floods, and fourthly in furnishing a splendid source of water power now unavailable. According to hydraulic experts 1,160,000 hp can be generated by the water powers exclusive of Niagara. This amount of hydraulic power would involve a saving of $25,000,000 annually over the same amount of power generated by steam.

BROOKLYN PUBLIC LIGHTING.—A decision has been handed down by Judge Burr in the suit of the Edison Electric Illuminating Company, of Brooklyn, against the city. The total claims of the company for public lighting from January 1, 1903, to February 1, 1906, aggregate, approximately, $1,800,000, not counting interest. Judge Burr's decision is that the company had a binding contract during the year beginning March 15, 1904, covering upwards of $600,000 of the total. A recent decision in an action of the Brooklyn Union Gas Company to the effect that the fixing of maximum prices by the Legislature from July 1, 1905, constituted a legal right to charge at such prices, gave the Edison Company a right to collect its claims in full from July 1, 1905, to February 1, 1906, aggregating a further amount of $300,000. Hence the court has thus far allowed half the total claim in full with interest. The remaining $900,000 covers periods during which no maximum rate has been fixed by the Legislature and no contract existed between the city and the company. The company has, therefore, to prove the reasonable value of the service rendered before obtaining a verdict in the court. The Edison Company is confident, however, that it will succeed in its establishing the reasonableness of its claims in their entirety.

CANADIAN SEA TELEGRAPHS.—It is stated, from Picton, Nova Scotia, that the Canadian Government wireless telegraph system may be brought into use for the sending of commercial messages between the mainland and Prince Edward Island, thus affording the islanders relief from their present telegraphic isolation, which has existed since the cable of the Anglo-American Company was broken on January 5. The acting minister of public works, Mr. Fisher, at Ottawa, has been in communication with the Anglo-American Company's office on the island with regard to repairing the cable, but as the break is believed to be in deep water, at about the middle of Northumberland Strait, it would be necessary to use a cable ship to make repairs. It is understood that the company is unwilling to send a cable ship to that point until the ice goes out in the spring. The Government maintains a wireless station at Cape Bear at the southeastern extremity of Prince Edward Island, from which it is able to send messages to the mainland of Nova Scotia by means of the Government steamers *Minto* and *Stanley*, equipped with wireless apparatus. It has been intimated that although the Anglo-American Company claims that it has a legal monopoly of commercial telegraph service between the island and the mainland, the Government may force it to permit the transmission of commercial messages by way of the Government wireless system, on the ground that the company has broken its contract by refusing to repair its cable.

JAMAICAN EARTHQUAKE.—Last week, on January 14, Kingston, Jamaica, West Indies, was visited in the afternoon by a disastrous earthquake, followed by fire. Hundreds of persons were killed and hundreds injured. The street car and electric lighting systems were badly disrupted and at last reports are still out of operation, as well as the water and gas works. The telegraph and telephone lines also continue broken down, and the sea cables have all been interrupted. The West India & Panama Telegraph Company, which is the principal means of communication between Jamaica and the outer world, received a report from its West Indian superintendent showing the extreme difficulties under which the line is working, and the steps taken to cope with the situation. The dispatch says: "The entire Kingston plant was destroyed. One of the male operators was injured and Miss Thomas, a woman operator, was killed. Only one cable instrument, of the antiquated mirror type, was saved. This is installed in a hut on the roadside, about ten miles outside of Kingston. Connection has been established from there to Holland Bay, but there is no line connecting the hut with Kingston. The manager of the Kingston office, who is working single-handed in the hut, is exhausted, owing to scant food and shelter. An enormous glut of dispatches is accumulating at all the Jamaican outlets. The staffs of the cable offices are overwhelmed and demoralized from family and property losses. A large staff of emergency cable operators is being hurried from Santiago, Cuba, and St. Thomas to Holland Bay, which temporarily will be our main point." Under the foregoing circumstances the West India & Panama Company was compelled for some time to refuse the British Government and other requests for the expedition of dispatches, on the ground that it threatens completely to break down the already crippled service.

A REFORM PROGRAMME.—Mr. Mark Fagan, the "reform" Mayor of Jersey City, in a communication to the Board of Street and Water Commissioners, has declared himself in favor of municipal ownership of trolley lines and electric light plants. He advocates the passing of an ordinance requiring the gas company to furnish gas of a certain quality and suggests a bill to be introduced into the Legislature for the establishment of a public utility commission with power to regulate such corporations, and to prescribe the quality of service they shall render and fix rates.

ELECTRIC SMELTING IN CALIFORNIA.—Considerable interest is being taken in California in the announcement that the Northern California Power Company will build a 50-ton experimental electric smelting plant for iron ores, to be located six miles east of Kermet, near the confluence of the McCloud and Pit Rivers. Operations are under the supervision of W. S. Morgan, of San Francisco, and a force of about 25 men is at present employed. A new post office has been established and is called Heroult, in honor of the physico-chemist. President H. H. Noble, of the Northern California Power Company, is very sanguine as to the future of the great iron beds of Shasta County.

MAGNETIC CLUB.—At the annual meeting of the Magnetic Club of New York City on Jan. 10, the secretary's report showed the membership at the close of the fiscal year to be three hundred, and the treasurer reported a balance in the treasury of $105.97. The following officers were elected for the ensuing year: President, George H. Usher; first vice-president, Marston R. Cockey; second vice-president, B. M. Downs; third vice-president, D. W. McAneeny; fourth vice-president, Theodore L. Cuyler, Jr.; secretary, W. H. Mathews; treasurer, Joseph J. Cardona; governor to serve one year to fill vacancy, M. H. Kerner; governors to serve two years: Wm. H. Baker, Chas. P. Bruch, F. E. McKiernan, Charles Shirley.

NEW YORK STATE TAXES.—The State Tax Commission in its report to the New York Legislature has recommended a graduated inheritance tax. Another recommendation is that corporations should be taxable only on their real estate and their franchises, and that on the other hand State franchises and license taxes should be considerably increased. The bills it recommends provide that there should be a single rate of 1½ per cent on the gross earnings of all public service corporations in the State, striking out the provision for taxing dividends. The commission also recommends that the stock exchange tax on the exchange of securities be continued, but that the method of imposing the tax be changed and that the tax be assessed upon the market value of the securities instead of on the par value.

AN INDUSTRIAL SCHOOL.—At Worcester, Mass., recently Mr. Magnus W. Alexander, of General Electric Company, Lynn, Mass., in Washburn Hall, pleaded for an industrial school on an elaborate scale in Worcester. He estimated the cost roughly at between $40,000 and $50,000 for construction, and figured that the annual maintenance would be approximately $20,000. He declared himself in opposition to the immediate State or municipal control of such an industrial school, arguing that such a project must necessarily work out its own end to a practical point before it can be accepted as a successfully tried theory. Dr. Carroll D. Wright also favored the industrial trade school everywhere in the land. He characterized the youth of Massachusetts, between 14 and 16 years of age, that escape the jurisdiction of the school authorities at 14 years, and drift into the lower grades of employment, as a menace to the country. In this expression he was corroborated by Mr. Alexander. The addresses were made at a co-operative meeting of the Public Educational Association, Mechanics' Association, Worcester Board of Trade and Metal Trades Association.

TELEPHONY IN FRANCE.—United States Consul-General Robert P. Skinner, of Marseilles, reports that, as is well known, general telephonic communication in France is a Government monopoly. In the large cities, like Marseilles, one does not rent an instrument at so much per year without further responsibility therefor, as in America. One begins by making application for connection and service. For this a fixed rental is paid, after which one pays the State for the wire used in making the connection, and finally purchases the instrument itself. But the instrument cannot be adopted in the public service unless it is of a type approved by the State and bears the Government stamp. Consequently manufacturers who desire to engage in this business have to submit their types to the Directeur de l'Exploitation Telephonique et Telegraphique, at Paris, for inspection, and if they are found acceptable each instrument must be marked. Nor is this all, for the mark is good for one year only. If the instrument be not sold before the expiration of one year the dealer must send it back to Paris to be remarked and run the risk of its rejection, this risk, however, being remote. The telephone service in Paris was the subject of notes in our issues of the last two weeks.

NEW YORK SUBWAYS.—The Municipal Art Society, of New York, has issued a pamphlet on subway transit in which one fare from the Battery to the northern end of the city line, to Brooklyn, and to Queens and over into Jersey is advocated. It is contended that the growth of the city is seriously impeded by a privately controlled transit system operated and extended primarily for dividends and stock inflation. The pamphlet advocates building new subways over such routes as to compel the present system to take them at the city's terms or face competition. The three commissioners appointed by the Appellate Division of the Supreme Court to consider four proposed subway routes which comprise the so-called Manhattan and Brooklyn loop lines and which have already met with the approval of the Board of Estimate, have refused to approve a subway under William Street, which is part of the McDonald plan, as amended by the Rapid Transit Commission. The chief reason for refusing to approve of this plan is the danger to property which would be caused by extensive excavation in the quicksand and saturated soil under the street. The commissioners approve the proposed bridge loop railway to run up Center Street, the Beekman Street Railway to connect with the present subway at City Hall Square, and of the Maiden Lane Railway to connect with the proposed Fourteenth Street system at Maiden Lane and William Street.

CLEVELAND ADVERTISING.—The Illuminating Company, of Cleveland, O., is doing some excellent advertising in the daily papers, aimed at the regular wants of the public in light, heat, power, etc. A good large space is occupied with bold display and pica sizes of type. The following passage is a sample of the work, omitting the display type: "Warm milk for the baby may be had in the nursery on short notice—heated in an electrical milk warmer. The current consumed is a trifle. The device may be attached by plug and cord to any lamp socket in any room. Quick relief may thus be afforded at any hour of the night in the event of illness. The electrical heating pad is much better than any hot water bottle. It does not leak—needs no refilling—never gets cold. It is so light its weight is never felt by the baby. Advantages of electric light are too apparent to need comment. They are becoming indispensable in every well equipped household. Cooking utensils—bath room conveniences—luminous radiators—coffee percolators, etc., may be operated with electrical current at very moderate cost. They render housekeeping easy and attractive. For illumination electric light is cleaner—safer—wholesomer—than any other. It is more convenient and more attractive. Wire your house now on the threshold of winter. The cost will be moderate and may be paid in monthly installments. Call Bell Main 2401 or Cuyahoga Central 5860 for information desired."

Hydro-Electric Plant at Kakabeka Falls, Canada.

By W. G. Hewson.

ONE of the most recent of Canadian hydro-electric installations to be placed in service is that of the Kaministiquia Power Company. The plant is used to supply the town of Fort William with electricity for all purposes. The power is generated at Kakabeka Falls on the Kaministiquia River, 25 miles west of Fort William, and is transmitted to the town by two lines on a single right of way, and is there distributed from a sub-station. The whole equipment is of the latest approved manufacture and while the buildings themselves are not works of art, they are absolutely fire-proof, being built entirely of structural steel and reinforced concrete.

The load at present is not large, the only contracts being with the municipality for light, two grain elevators for power and light, a flour mill and a few small manufactories. However, it cannot be long until a much larger business is obtained.

Port Arthur and Fort William, only three miles distant from each other, are situated at the head of navigation of the Great Lakes, and so are the point of change, from rail to water, or vice versa, of the heavy freight traffic that must pass through that district. Some idea of the amount of grain transferred at these ports may be had from the fact that there are nine elevators between them and one of these the largest of its kind in the world.

Port Arthur, being the division terminus of the Canadian Northern Railway, and Fort William that of the Canadian

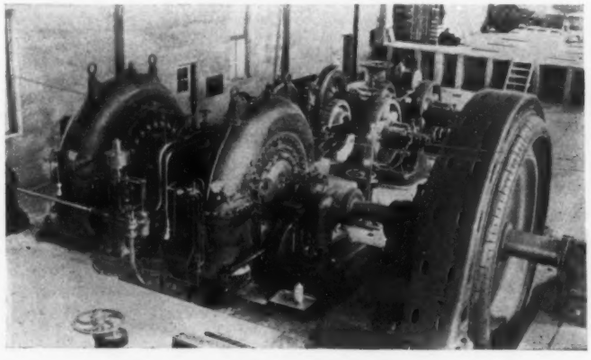


FIG. 1.—INTERIOR OF POWER HOUSE.

Pacific and new Grand Trunk Pacific, they contain the division headquarters and machine shops of these three roads. If all reports are true it is the intention of the Canadian Pacific Railway to install electric locomotives for all yard switching. The Ogilvie Milling Company, which controls the power company, has just erected a new elevator and flour mill, the latter having a capacity of 5,000 barrels a day.

Considering the situation of the generating plant and the distances from which materials had to be brought, the plant was erected in a very short period of time. Work on final plans and on the installation itself was commenced simultaneously early in June, 1905, and power was in Fort William early in September, 1906.

The installation at the generating station, shown in Fig. 1, consists of two 5,000-kw, 4,000-volt, three-phase, star-wound alternators, each direct-connected to a 6,786-hp twin reaction water turbine with horizontal shaft of Voith design and manufacture; two 150-kw, 125-volt, direct-current generators, each direct-connected to a 250-hp, single reaction turbine of similar manufacture to the large wheels; and two banks of three transformers each and each transformer of 1,675 kw capacity of the air-blast type, 2,300 to 14,475 volts.

Water for the turbines is diverted from the river just above the Ecartè Rapids, at a point one mile above the falls. It first passes through a heavy wooden grating into an inlet bay and from there through an iron grating into a concrete aqueduct, by which it is conducted to the forebay situated on the bluff overlooking the power house. As the river is perfectly smooth for a distance of four or five miles above the intake, it is frozen over early in the winter season, so that little trouble is expected with slush or anchor ice. The iron rack, in front of the concrete aqueduct, may be swept by a strong cross current by

FIG. 2.—PENSTOCKS IN COURSE OF CONSTRUCTION.

opening a sluice gate at one side and thus help with the removal of any slush ice or floating refuse.

The aqueduct is of reinforced concrete 7,200 ft. long, 10 ft. inside diameter, 4 in. thick and its axis is practically horizontal. At normal operation there will be a head of 15 ft. of water on it. The reinforcing is of mild steel and consists of 9/16-in. circular hoops 10 ft. 4 in. in diameter, spaced 6 in. apart and interlaced with 5/16-in. rods, laid lengthwise of the pipe, every 6 in. around the periphery. This use of reinforced concrete has proved very satisfactory, especially in places where the pipe rests on a rock foundation or where a trench had to be dug to bring it to the correct elevation. The wooden forms were made in bolted sections, so that they were able to be used a number of times. After the concrete had set both the inside and the outside was brushed and then a coating of tar and rosin applied to the inside.

The forebay is also of concrete construction and is provided with a syphon type of spillway to prevent it from freezing up during the severe winter season.

The two penstocks, shown in Fig. 2, are 7 ft. 6 in. inside diameter, about 500 ft. long, and are composed of soft steel sheets riveted together. They are supported in iron saddles set on concrete piers every 12.5 ft. Any expansion or contrac-

FIG. 3.—EXTERIOR OF POWER HOUSE, SHOWING SWITCH TOWER.

tion is taken care of by the pipe so moving on the curvers that any severe strains are relieved. The entrances to each of the two turbines are guarded by heavy cast-steel wicket gates.

At present each of the exciter turbines is supplied by a 22-in. penstock, which is tapped into the large penstocks at the foot

of the hill. Provision has been made for a 22-in. pipe direct to the forebay.

The electricity is conducted from the generators to selector switches, located in cells near the transformer air chamber, in lead-encased cables laid in tile ducts under the floor. In normal operation each of these switches will connect its generator both to a 4,000-volt bus, through a solenoid operated oil switch, and also directly to the primaries of one bank of transformers. In case of trouble with either the generators or the transformers current may be taken from one machine through its selector switch to the 4,000-volt bus and delivered to the other bank of transformers through the second selector switch. The 4,000-volt bus is also used as source of power in the station for lamps, blowers, etc., as well as for synchronizing.

All transformer leads are of lead-encased cables, and enter the cases from ducts hung from the roof of the air chamber. The high-tension sides are arranged in two sets of 25,000-volt buses, in parallel, by a motor-operated oil switch. If desired disconnecting switches may be used to keep these buses separate from each other. The high-tension switches mentioned above are located on the same floor as the transformers, immediately behind them; the leads from them to the buses are of bare conductor, supported on insulators. The buses are on the second floor of the tower shown in Fig. 3. Each of the buses, as well as all leads to and from them, are completely separated from each other by concrete or soapstone barriers, as indicated in Fig. 4, thus minimizing any spread of accident from one conductor to another.

There are two motor-operated oil break switches (Fig. 5) on the third floor of the towers that are used to connect the high-tension buses to either or both 25,000-volt transmission lines that leave the building on the fourth floor. On this fourth floor are also placed the low-equivalent lightning arresters and their choke coils.

The transmission lines, which are of No. 2-0 hard-drawn copper wire, leave the building through heavy glass plates set in 12-in. tile and are protected on the outside from the weather by a concrete shelter, as seen in Fig. 2. Each of the two lines, which are placed on opposite sides of the road allowance, carries a three-phase circuit, the conductors being placed at the vertices of an inverted equilateral triangle. Guard wires of No. 6 galvanized-iron wire are run along the pole tops and also along the outer ends of the upper cross arm. All poles

FIG. 4.—BUS-BAR COMPARTMENTS.

are of cedar and are set at least 4 ft. in the ground, and at railway crossings they are placed in a very solid foundation of concrete.

Stranded copper cable is used at these crossings instead of the solid conductor. One line carries a metallic telephone circuit transposed every quarter of a mile.

The complete electrical equipment, which is of Canadian General Electric manufacture, is connected in star with grounded neutral, except on the low-tension side of the sub-station. Each of the oil break switches is equipped with time relays and also with hook type disconnecting switches. The control wires, as well as lighting and instrument circuits, are carried to the switchboard in conduits. For handling the heavy parts of the machines a 35-ton Niles crane has been installed. The crane motors are supplied with current from the exciter generators.

The switchboard is thoroughly up to date both in the manner of control and also in the apparatus used. No e.m.f. higher than 125 volts is found near it. The transformers are set in concrete cells in a gallery beneath the 4,000-volt buses and the current transformers are placed on concrete shelves in similar cells behind the high-tension oil switches. In order that the attendant may know the exact character and size of load on the station, each generator panel is provided with wattmeters

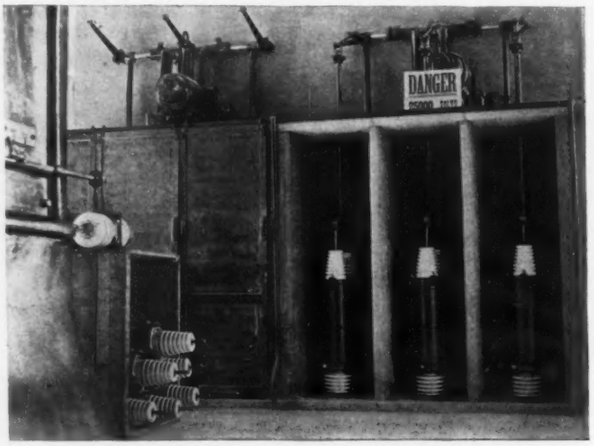


FIG. 5.—MOTOR-OPERATED HIGH-TENSION SWITCHES.

and watt-hour meters, a power factor meter, a voltmeter, an ammeter and the usual equipment of direct-current field circuit ammeters.

The field circuit switches have the usual discharge resistance and are supplied from a selector switch so that the exciting current may be taken from either of the two buses. All rheostats, being motor-operated, are able to be placed in a gallery beneath the switchboard.

It is the intention to equip each generator governor with switchboard control so that synchronizing may be done entirely by the switchboard attendant, after water has been admitted to the wheel casings.

The present plant is capable of developing only 12,000 hp, but it is the intention of the promoters to install three more units each of 6,000 hp as soon as the demand requires it. Provision has been made for this increase throughout the plant by leaving openings in the intake and forebay walls for two more concrete aqueducts and in the forebay for three more penstocks.

On the switchboard four blank panels have been installed for the three generators and two transmission lines. Either of the exciters of the present plant is capable of exciting all five machines if necessary. The only addition to the power house to complete the installation will be the generators. However, to obtain sufficient water supply for all periods of the year, reservoirs will have to be built at Dog Lake, 40 miles up the river.

At the sub-station in Fort William the transmission lines enter at one end of the building and pass through choke coils situated with their arresters on a gallery, to motor-operated oil switches and from there to the primaries of one bank of transformers. Two 2,200-volt buses are supplied from the secondary windings through similar motor-operated switches and each of the outgoing feeders is connected to either of these by high-tension oil-break switches mounted on panels.

The engineers for the company were William Kennedy, Jr., and R. S. Kelsch, consulting engineers, and R. W. Leonard, resident engineer. The electrical equipment was installed by A. E. Gregory.

The Leakage Reactance of Induction Motors.

BY A. S. MCALLISTER.

AS will be appreciated at once from a glance at the simplified circuit diagram and the circular current locus of an induction motor, the maximum power which the machine can possibly absorb at normal e.m.f. depends almost exclusively upon the combined local leakage reactance of the primary and secondary windings. It will be seen, therefore, that of all the calculations connected with the predetermination of the performance of a certain design none is of greater importance than that dealing with the leakage reactance. Although numerous theoretical equations are available for determining the reactance, the fact remains that only those that are formed upon an experimental basis are found to give results in conformity to observation under test. In the outline treatment below an attempt is made to arrange in simple form certain design constants that have long been in use for predetermining the performance of induction motors, and to show the relation these constants bear to the leakage reactance, and thereby to investigate the facts upon which the reactance depends.

Beyond any doubt the simplest and at the same time the most reliable equation that has ever been derived for assisting in the design of induction motors is the one given by Mr. B. A. Behrend on page 803 of the issue of the ELECTRICAL WORLD AND ENGINEER for November 24, 1900, namely,

$$\sigma = C\,\frac{\Delta}{t}, \qquad (1)$$

in which σ is the "leakage coefficient," as illustrated below, Δ is the radical depth of the air-gap, t, the pole pitch and C, which is designated as the "dispersion factor," depends for its value upon the arrangement of the slots and the conductors. Since σ is a ratio, the value of C is independent of the units in which Δ and t are expressed. However, in what follows all lengths will be considered as measured in centimeters.

The leakage coefficient, σ, may be defined briefly as the ratio of the length, NO to OK, in the circle diagram of Fig. 1. Referring now to the simplified circuit diagram of Fig. 2, upon which the simple circle diagram is based, it will be noted that NO is the synchronous no-load exciting current of the motor,

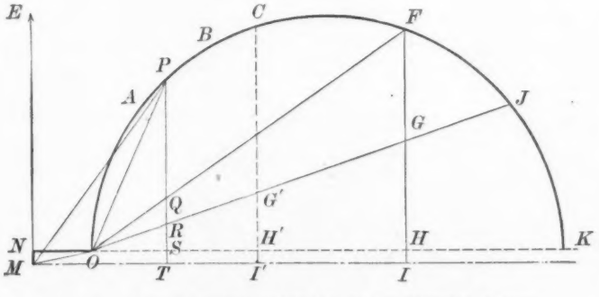


FIG. 1.—SIMPLE CIRCLE DIAGRAM OF INDUCTION MOTOR.

while OK has a value which would be represented by the ratio of the primary voltage, E_p, to the combined primary and secondary leakage reactance, $(X_p + X_s)$. Obviously when the value of σ and either NO or OK are known, the main features of the circle diagram can be constructed and the maximum power factor and maximum input can be determined at once. On account of the convenience of the method, the value of NO is ordinarily first calculated from the mechanical dimensions of the rotor and stator, the arrangement of the primary coils and the magnetic density in the air-gaps, and then OK is ascertained by the use of formula (1). It might thus appear that the "short-circuit" current is made to depend upon the radical depth of the air-gap, the magnetic density, the pole pitch and the exciting current; as a matter of fact, however, the leakage reactance as found from the above equation, and therefore the "short-circuit" currents, are tacitly assumed to be entirely independent of all of these quantities. It is the object of the present article to give a physical interpretation to the quantity, C, and to discuss in detail the facts upon which its value depends.

Mr. Behrend has shown that the exciting current can be determined from the formula:

$$i_o = \frac{1.6}{2\sqrt{2}} \cdot \frac{B\Delta}{n}, \qquad (2)$$

where B is the magnetic density in the air-gap and n is the

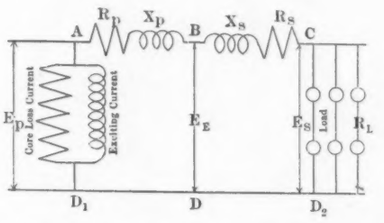


FIG. 2.—SIMPLIFIED CIRCUITS OF INDUCTION MOTOR.

number of conductors per pole per phase, i_o being the current per phase. He has shown also that the primary voltage per phase can be represented as

$$e = \frac{1.24}{10^8} f\,p\,n\,b\,t\,B, \qquad (3)$$

where f is the frequency, p is the number of poles and b is the width of the motor.

Let the combined primary and secondary leakage reactance per phase be represented by $x_p + x_s$, then

$$\frac{e}{x_p + x_s} = \frac{i_o}{\sigma}. \qquad (4)$$

Combining equations (1), (2), (3) and (4),

$$\frac{1.24}{10^8} \cdot \frac{f\,p\,n\,b\,t\,B}{x_p + x_s} = \frac{1.6}{2\sqrt{2}} \cdot \frac{B\Delta\,t}{n\Delta\,C}. \qquad (5)$$

Thus,
$$x_p + x_s = \frac{2.19\,C}{10^8} f\,p\,b\,n^2. \qquad (6)$$

Considering momentarily that C is a true "constant," the interpretation of equation (6) would be that the effective leakage reactance per pole varies directly with the square of the number of conductors per pole, and as the width of the motor, and is independent of the pole pitch and the depth of air-gap.

A little consideration will show that the actual inter linkage of leakage flux and conductors will vary somewhat with the number of slots in which the conductors are placed, that it is not entirely independent of the pole pitch, and that it will depend largely upon the reluctance of the leakage path; it will vary slightly with the depth of the air-gap, and largely with the shape of the slots. Upon these various modifying influences will depend the true value of the factor, C.

In an article which appeared in the issue of the ELECTRICAL WORLD AND ENGINEER for April 30, 1904, Mr. H. M. Hobart reported the results of calculations and tests on 57 induction motors of eight different manufacturers in four different countries, and gave curves, based on the tests of these machines, showing in what manner the leakage coefficient depends upon the pole pitch, the slot opening, the air-gap and the number of slots per pole. The above-mentioned curves have been reproduced in Figs. 3 and 4 herewith, which, however, have been plotted with co-ordinates somewhat changed from the ones employed by Mr. Hobart, on account of the fact that the new

scales chosen allow the results to be readily expressed in the form of simple equations that permit of easy interpretation. The "dispersion factor," C, is considered as made up of two components, c and c'; the former depends upon the shape of the slots and the ratio of the pole pitch to the core length, and the latter depends upon the depth of the air-gap and the number of slots, thus:

$$C = c\,c'. \tag{7}$$

Valves for c are given in Fig. 3, while Fig. 4 shows valves for c'.

The heavy lines in Fig. 3 are the curves replotted from Mr. Hobart's results. The curve for the completely closed slots can be represented with considerable accuracy by the following equation:

$$c_c = 10.5 + \frac{2.9\,t}{b}. \tag{8}$$

Likewise the curve for the wide open slots is fairly well represented by the equation

$$c_o = 5.0 + \frac{2.9\,t}{b}. \tag{9}$$

The graph of each of these equations is shown as a broken line near the corresponding curve.

The interpretation of equations (8) and (9) when used in conjunction with equation (6) would be that the leakage reactance consists of two parts, one of which varies directly with the pole pitch and the other directly with the length of the core; for wide open slots, the latter is 1.72 times as large as the former per unit length, while with completely closed slots the latter is 3.62 times as large as the former.

It is permissible to assume that if all other conditions remain unaltered, the decrease in the leakage reactance for the "embedded" length varies directly with the percentage opening of the slots. Equations (8) and (9) can, therefore, be combined as follows:

$$c = 10.5 - 5.5\,S_o + \frac{2.9\,t}{b}, \tag{10}$$

where S_o is the percentage opening of the slots. Equation (10) gives the main dispersion factor.

The true physical significance of equation (10) can be pointed out most clearly by assuming temporarily a value of unity for the factor c' in equation (7), and combining equations (6), (7) and (10). Thus,

$$x_p + x_s = \frac{2.19}{10^8}\,(10.5\,b - 5.5\,S_o b + 2.9\,t)\,f\,p\,n^2, \tag{10a}$$

which shows at a glance the relative importance of the "embedded" length and the "free" length of the primary coil in contributing to the local leakage reactance of the windings, as noted above.

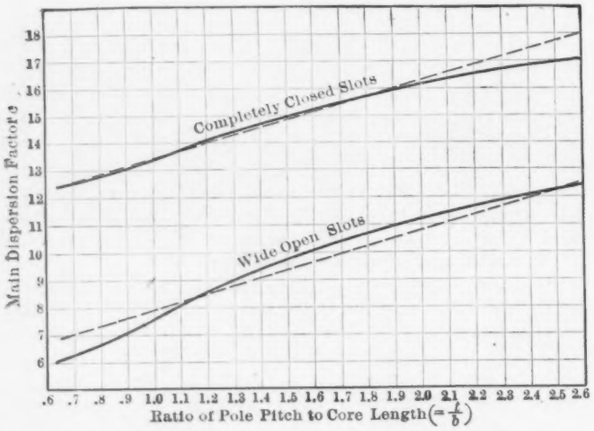


FIG. 3.—MAIN DISPERSION FACTOR FOR OPEN AND CLOSED SLOTS.

Values for c' as found by Mr. Hobart are shown by the heavy curve in Fig. 4. A fair approximation to this curve is given by the following equation:

$$c' = .54 + \frac{.247}{\Delta\,.\,h}, \tag{11}$$

where h is the average number of the stator and rotor slots per pole per phase. The broken line in Fig. 4 is the graph of equation (11). According to this equation a certain portion of the leakage reactance varies inversely with the number of slots in which the conductors are placed, and also inversely with the depth of the air-gap. This portion may be designated as the "zigzag" leakage reactance, and c' can be known as the "zigzag" dispersion factor.

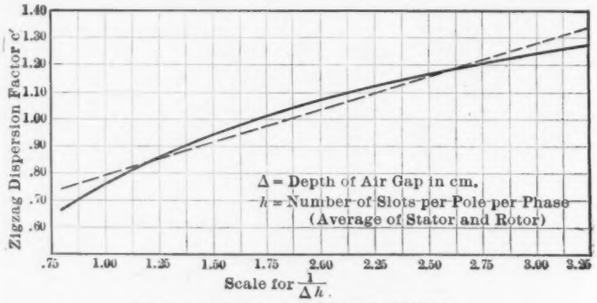

Zigzag Dispersion Factor c'
Δ = Depth of Air Gap in cm.
h = Number of Slots per Pole per Phase (Average of Stator and Rotor)
Scale for 1/(Δ h)

FIG. 4.—ZIGZAG DISPERSION FACTOR.

Combining equations (7), (10) and (11), the value of the total "dispersion factor" becomes

$$C = \left(10.5 - 5.5\,S_o + \frac{2.9\,t}{b}\right)\left(.54 + \frac{.247}{\Delta\,.\,h}\right) \tag{12}$$

It will be observed that the straight line graphs of equations (8), (9) and (11) do not coincide with the corresponding curves in Figs. 3 and 4. It is worthy of note, however, that calculations of the leakage coefficients of the 57 different motors mentioned above when made according to the straight line graphs agree with the actual test upon these machines equally as well as do those based on the heavy curves. Moreover, the equations upon which the straight line graphs are based are interpretable strictly according to physical facts, while the interpretation of the deviations of the heavy curves from straight lines are involved in a considerable maze of guesswork.

It is evident at once that the "main dispersion factor" considers all of the conductors of each pole winding to be cut by all of the leakage lines due to the currents in these conductors, while the "zigzag leakage factor" assumes the leakage lines due to the current in the conductors in each separate slot to surround only this particular slot. Neither of these assumptions is absolutely correct, but it is believed that the relative importance of the facts underlying the separate assumptions are properly accounted for in equation (12).

It should be noted carefully in this connection that all the equations recorded in this article deal with empirical constants, and it is not permissible to extrapolate beyond the range covered by the tests. It is believed, however, that for induction motors of relatively standard pattern, excluding all freak designs, the equations and curves furnish a reliable basis for calculations.

Equation (12) shows plainly the various quantities which affect the value of the local leakage reactance, as given by equation (6), and it indicates that the dispersion factor in equation (1) is not a true "constant." It is well worthy of note, however, that the original statement by Mr. Behrend that the value of C for half open slots varies between 10 and 15, is fully confirmed by the tests of the 57 motors mentioned previously. The fact of the matter is that a motor so designed that, when analyzed according to equation (12), the value of C is less than 10 or more than 15, with $S_o = .5$, is of such extreme dimensions that it will probably not be a commercially desirable machine.

Experiments With High Potentials.

During the congress held recently in Milan by the Italian Electrotecnic Association some experiments with exceedingly high potentials on cables and aerial lines were conducted in Messrs. Pirelli's Pavillon at the Milan Exhibition by their electrical engineer, E. Jona.

For these experiments a 150-kw transformer was built in Messrs. Pirelli's works; the primary was wound for 160 volts and fed from the town mains. The secondary was wound in two similar groups of coils, which can be connected in series or in parallel. A potential of 320,000 volts or 160,000 volts can thus be obtained.

By the use of an electrostatic voltmeter a potential of 200,000 volts could be directly measured. For higher potentials the voltmeter could be connected across one of the secondary coils, thus measuring one-half of the total voltage available at the terminals.

EXPERIMENTS ON HIGH-TENSION CABLES.

In the pavillon had been placed two drums, each wound with a high-tension cable 120 meters long. The cable, shown full

FIG. 1.—HIGH-TENSION AERIAL CABLE.

size in Fig. 1, is insulated with various layers of different dielectrics, partly vulcanized India rubber, partly paper, and sheathed in lead. One of the ends of each of these two coils was joined up to one of the terminals of the secondary of the transformer (connected in parallel) the other two ends were joined to a number of vacuum tubes connected in series and so shaped as to form the words "150,000 volts." A small condenser was also placed in series with the vacuum tubes. The condenser was formed by two movable copper discs separated by a disc

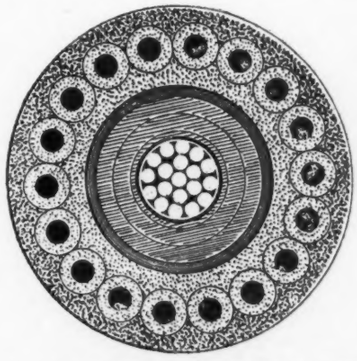


FIG. 2.—HIGH-TENSION SUBMARINE CABLE.

of ebonite; the distance between the plates could be regulated in order to absorb more or less voltage, to obtain good brilliancy at the tubes. This condenser was necessary because the impressed voltage was too high for the tubes. In this manner the cables formed part of an electric line working steadily at 150,000 volts.

A few sample lengths of 5 or 6 meters of this cable were tested up to the breakdown voltage. To accomplish this the ends of the cable had to be prepared with great care to obviate surface discharges. The tension could be gradually increased by

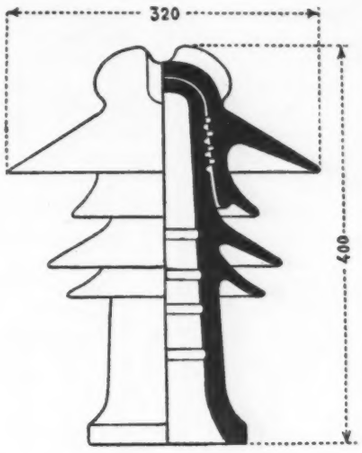


FIG. 3.—60,000-VOLT INSULATOR.

means of a suitable resistance in the primary circuit of the transformer. These samples broke down respectively at 208,000, 202,000, 210,000 volts, applied between the conductor and the lead sheathing. This shows a very high dielectric strength, because the conductor has about 18 mm. diameter, while the total diameter over the insulation is 48 mm., thus giving a total thickness of dielectric of only 15 mm. It should be observed that in these cables the copper strand is sheathed with lead, thus making the conductor absolutely cylindrical. That may produce a diminution in the potential gradient in the very first stratum of dielectric, of something like 20 or 30 per cent, or even more.

Some samples of the cable recently laid by Messrs. Pirelli across the Lake Garda, for the transmission of 6,000 kw three-phase current at 13,000 volts pressure from Ponale to Rovereto were also tested to break down voltage. This cable, shown full size in Fig. 2, offers some interesting features. The stranded conductor of 75 mm. is sheathed in a lead tube, and

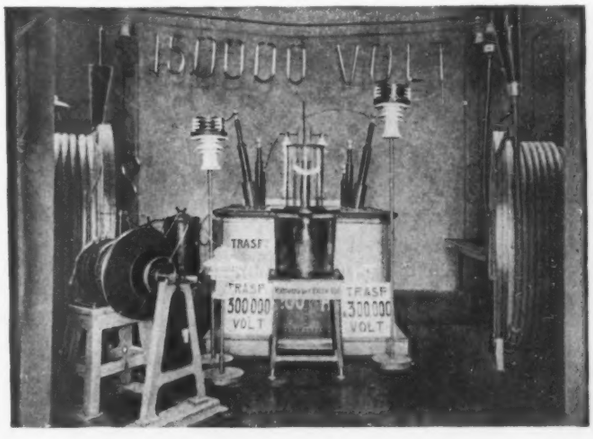


FIG. 4.—GENERAL ASSEMBLY OF APPARATUS.

subsequently insulated by several layers of vulcanized India rubber up to a total thickness of 5.5 mm. Then follows a coating of 1.2 mm. of gutta-percha to insure absolute imperviousness to water. The core is then served with tanned jute and armored with 18 steel wires of 3 mm. diameter. The cable is single cored, three similar cables forming a three-phase line.

To avoid the effects of self-induction (fairly considerable in three separated steel-armored cables) each steel wire is previously wrapped with tarred hemp. Thus the magnetic and electric resistances of the cross-circuit are enormously increased, and the drop of pressure due to self-induction—according to the results of experiments—has been reduced to the same order of magnitude as the drop due to the ohmic resistance. Samples of this cable were tested up to 100,000 volts between the conductor and the sheathing. Violent sparks then sprung between the conductor and the sheathing, running along the surface of the dielectric, but the cable withstood this pressure. It was not possible to further increase the voltage, owing to these sparkings.

EXPERIMENTS ON AERIAL LINES.

In the garden near the pavillon had been erected an aerial two-wired line, carried by big porcelain insulators made by Richard Ginori. These insulators, illustrated in Fig. 3, are the largest ever made; they are designed for 60,000 volts and tested up to 160,000 volts. They have four petticoats 40 cm. high and 32 cm. in diameter. The line wires, which were hung 160 meters apart, consisted of copper strands of various diameter: 20, 40, 80, 100 sq. mm., in order to show the difference of the brush discharge according to the diameters of the strand. The experiment was made at night. When an e.m.f. of 50,000 volts

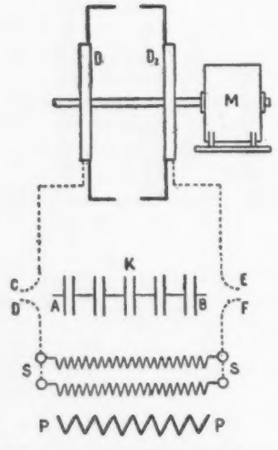


FIG. 5.—CONNECTIONS FOR TEST WITH ROTARY SPARK GAP.

FIG. 6.—HIGH-POTENTIAL VOLTMETER.

was reached, the smallest strand of 20 sq. mm. began to show brush discharge, while with the one of 100 sq. mm. the brush discharge did not begin until the e.m.f. reached 100,000 volts. The potential was then raised to 150,000, 200,000, 250,000 and 280,000 volts. At this potential the hiss of the line was very considerable; from the insulators, line, etc., there were bright brush discharges. The electrostatic fields were so intense in all the neighborhood that sparks could be obtained from any insulated metallic mass, and all vacuum glass tubes spontaneously lit up. At 290,000 volts an arc sprang from one of the insulators and set fire to one of the wooden supports, thus closing the experiment.

ROTARY SPARK-GAP.

In this experiment the tension of the transformer was lowered to 80,000 or 90,000 volts, and it was arranged to charge a battery of condensers. Two ebonite discs of 25 cm. radius and at a distance one from another of 250 mm. had been fixed on the shaft of a three-phase motor, as shown in Fig. 5. On the outer edge of the discs were two bronze rings, on which had been screwed two iron wires, the extremities of which were at a distance of 50 cm. from the shaft and at a distance of 10 cm. one from another. The armatures of the condensers were connected to these rings. The motor revolving with a speed of 1,200 r.p.m., the speed at the spark-gap was 60 meters per second.

One observed a brilliant circle of sparks that appeared to turn slowly in the opposite direction to that of the motor. The speed of this apparent rotation was the slip of the motor. It is needless to state that these violent and loud sparks were not in the best of harmony with the wireless station at the exhibition.

Fig. 4 gives a general view of the arrangements for these experiments. At the top in Fig. 4 can be seen the vacuum tubes, at the sides the two drums with the cable wound on, in the center the transformer, before which stands the 200,000 voltmeter. On the right-hand side can be seen the rotary spark-gap. Above the transformer but rather to the sides of it are two large insulators carried by two iron poles. Those insulators carry two self-induction coils, connected to the terminals of the secondary of the transformer. Their object is to stop the electrical oscillations, formed by the sparks, before they get to the transformer.

Fig. 6 represents the electrostatic voltmeter for measuring potentials up to 200,000 volts. It measures the attractive force exerted by the smaller fixed plate connected to one of the terminals of the transformer, on a small movable plate, connected to the other terminal. The apparatus is filled with paraffin oil. The larger plate is 50 mm. diameter and is at a distance of 280 mm. from the smaller plate.

The attractive force exerted on the larger plate at 200,000 volts is about 23 grammes. It may be a surprise to many to learn that the attraction developed by electrostatic forces on such a small plate (20 sq. mm.) can be so considerable.

Modern Harbor Cranes.

The modern harbor crane is operated in some instances by hydraulic motors, in others by electric motors, but very frequently by steam engines, the latter being largely employed on floating cranes, where electric power cannot always be obtained.

Among the various harbor cranes may be mentioned the revolving jib, two of which are illustrated in Fig. 1. Each of these cranes is of the hydraulic type and has a lifting capacity of 5.5 tons. They were constructed, for the Argentine Government, in Leeds, England, by Tannett Walker & Co. These cranes represent a type which is extensively employed on docks for loading and unloading vessels and transferring the cargo to cars which in many cases are allowed to pass through the portals of the cranes on side tracks provided for the purpose.

A French quay crane electrically operated is shown in Figs.

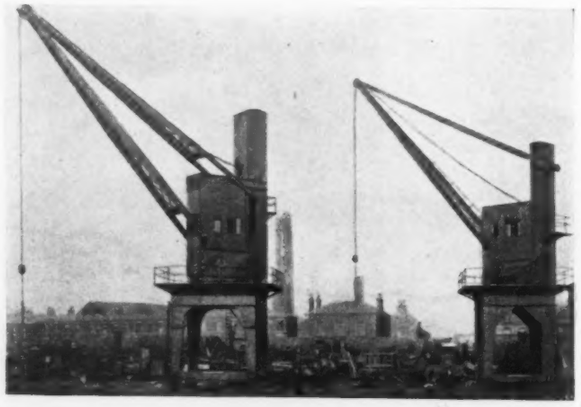
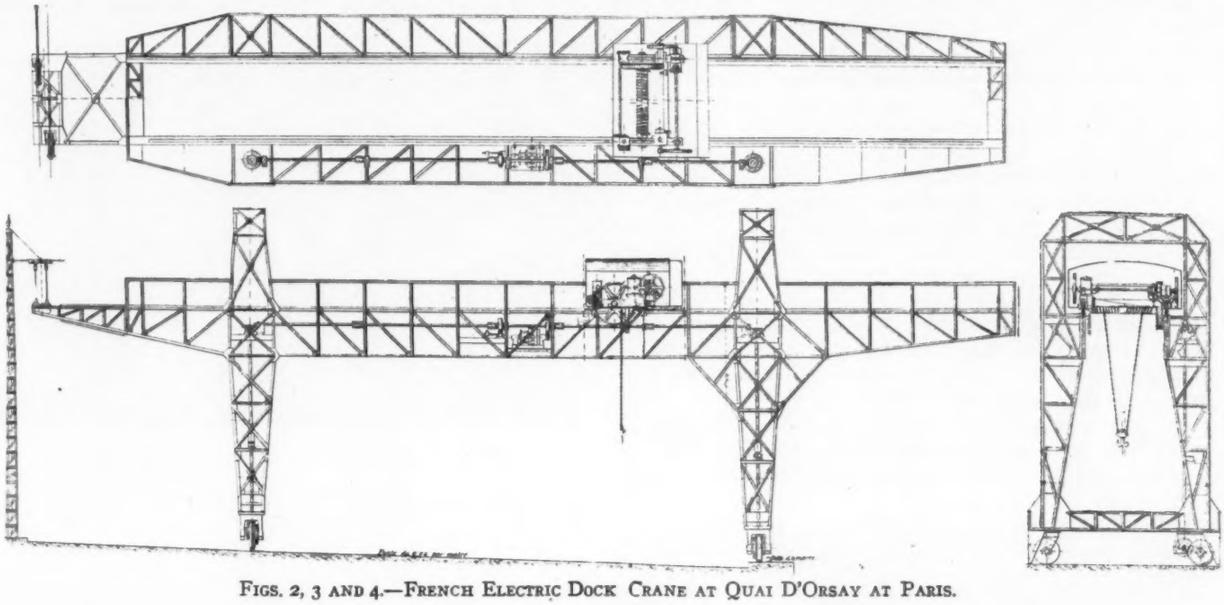


FIG. 1.—PORTABLE HYDRAULIC CRANES.

2, 3 and 4, the current for the motors of the crane being conducted from a pair of overhead wires supported by poles on the shore side, the whole bridge and crane traveling along the dock for a considerable distance. This crane was installed at the Quai d'Orsay at Paris for the Societe des Etab-

lissements postel-Vianey by the French Thomson-Houston Company. The total width of the crane is 19. feet, each pair of traveling supports being mounted on a two-wheel truck 21.5 feet long. The height of the bridge from the dock is 23 feet, and the total length of the same on which the electrically operated trolley moves is about 100 feet, while the overhang at the end at which the boats are loaded and unloaded is 30 feet and the distance between the supports which travel on the rails is 56 ft.

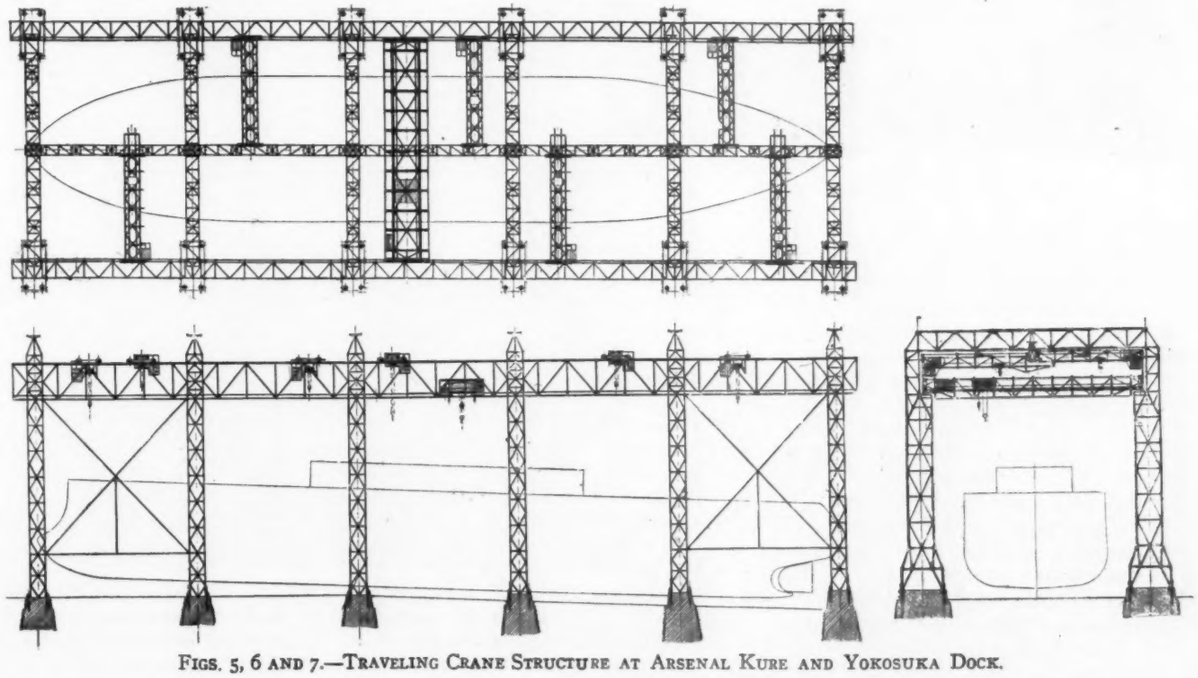
The crane is operated by an alternating-current motor at a pressure of 110 volts and is mounted on the bridge and connected to the traveling mechanism by a long shaft bevel geared to the wheels of the two supporting legs. The hoisting motor is mounted on the carriage and also propels the carriage along the bridge.



FIGS. 2, 3 AND 4.—FRENCH ELECTRIC DOCK CRANE AT QUAI D'ORSAY AT PARIS.

Another example of an electrically-operated crane is shown in Figs. 5, 6 and 7, which illustrate a crane installed at the Japanese arsenal, Kure and Yukosuka dock. This crane was built for the Japanese Government marine service by the Benrather Maschinenfabrik Aktien Gesellschaft of Benrath near Düsseldorf, Germany.

As will be noted by the drawing below this great structure is provided with several traveling cranes of small size and one large crane. The latter has a span of 100 ft. and a lifting capacity of 66,000 lbs. A war vessel or merchant vessel can be placed in the Yokosuka dock and the crane can travel over the ship from one end to the other, thereby handling material wherever desired. The total length of the structure is 412 ft.; it is supported by six pair of columns each 82 ft. high. The traveling motor of the crane is rated at 24-hp, and the



FIGS. 5, 6 AND 7.—TRAVELING CRANE STRUCTURE AT ARSENAL KURE AND YOKOSUKA DOCK.

crane may be moved at a speed of 200 ft. per minute. The carriage on the crane is provided with a 10-hp motor, and may be moved along the bridge at a speed of 82 ft. per minute. The main hoisting hook is operated by a 55-hp motor, and raises the heaviest load at a speed of 16.5 ft. per minute, while a smaller hook is operated at a speed of 35 ft. per minute by a 24-hp motor. Each of the half dozen smaller cranes has a span of only about half that of the main traveling crane and has a lifting capacity of 11,000 lb. These cranes travel along the structure above the main crane. The above-described crane affords an excellent example of a marine stationary traveling crane system for arsenals and docks where extensive repairing is carried on of large steamers and war vessels.

The power necessary for operating floating cranes must ordinarily be obtained from steam. A steam-driven floating crane of 60 tons capacity of German construction built by the Duisburger Maschinenbau-Actien Gesellschaft, formerly Bechem K. Keetman, and equipped with a steam engine and boiler constructed at Danzig, Germany, by J. W. Klawitter, is shown in Fig. 8. The pontoon on which this crane rests has a total length of 72 ft., a width of 50 ft., and a height of 7 ft. The boiler, engine and hoisting apparatus are mounted in an enclosure at one end of the pontoon, the four legs of the crane resting on the corners of the float.

This interesting floating crane is provided with a pump and water ballast compartments so arranged that 60 tons can be lifted at the greatest radius of action, 60 ft. beyond the pontoon,

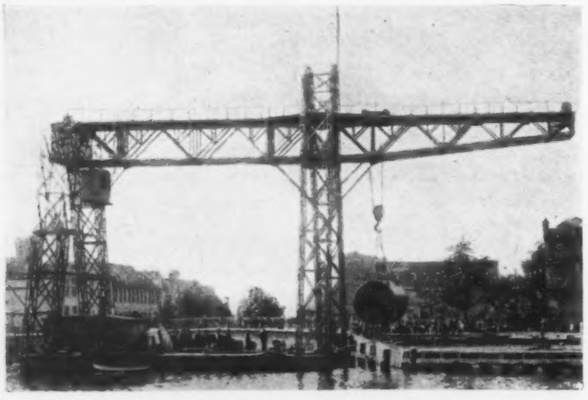


FIG. 8.—GERMAN FLOATING CRANE.

while 88 tons can be raised at 33 ft. without tipping the pontoon more than 4° 30′. The height of operation is 15 meters. The hoisting apparatus was constructed at Cologne, Germany, by Felten & Guilleaume. The hoisting cable has a diameter of 38 millimeters, and consists of 6 strands of 37 wires each 1.81 millimeters in thickness.

The hoisting drums are 2.5 ft. in diameter and are operated at such a speed with a load of 60 tons that the load is raised at the rate of 3.3 ft. per minute, and with a load of 10 tons the speed is increased to 20 ft. per minute, while the hoisting apparatus may be operated at a speed of 40 ft. a minute with a load of 5 tons.

The engines are of the vertical twin cylinder type having a rated output of 25 hp and operating at a speed of 200 r.p.m. The steam boiler supplies the necessary power to the pumps and for forcing the water ballast out of the tanks. This boiler operates at a pressure of five atmospheres.

One of the peculiar advantages of this form of floating crane is that there is ample space on the pontoon itself for storing engines and boilers of considerable size, as well as for motor boats, yachts and other material. The boilers and engines can thus be taken on board from the dock or piers by the crane and the whole pontoon towed wherever desired and the material deposited on board the steamers or other places.

High Power Wireless Telegraph Station.

At the small town of Nauen, about 25 miles from Berlin, there has been erected by the German Wireless Telegraph Company a high-power space telegraph station which is claimed to represent a considerable advance in the design of such stations in that by the special arrangement of the antenna a 330-ft. iron

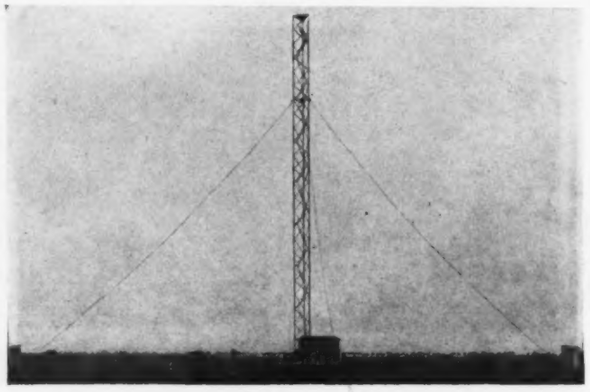


FIG. 1.— TELEGRAPH TOWER 330 FT. IN HEIGHT.

mast is used without loss of radiant energy. The tower is illustrated in Fig. 1. It is constructed in the form of a triangle about 13 ft. on each side. The three side girders are connected to one another by means of diagonal cross-stays; at the foot they are joined in a cast-steel sphere which rests on a socket constructed as a sole plate. The great weight of the tower is carried through a layer of insulation to the concrete foundation.

At a height of 245 ft. are fastened the guys, by which alone the tower is kept vertical. These guys lead with a considerable sag to points 625 ft. from the foot of the tower where they are anchored. The guys are of iron, but they are insulated from both the tower and the anchors. The three upper insulators are arranged in oil, which construction has proved entirely reliable. The lower anchorings of the three guys are secured by means of masses of masonry which are built almost entirely above ground, and withstand the great strain by means of their weight. In Fig. 1 these anchoring weights may be observed like small houses with sloping roofs.

The antenna spreads out from the top of the tower. It is constructed as a six-fold umbrella, and is so arranged that each two opposite segments balance one another through a pair of pulleys, fixed at the top of the tower, which serve also for hoisting the antenna. Each segment contains in its upper part nine phosphor-bronze cables; at one-fourth of its length each cable branches out into two fresh cables, so that in the bottom

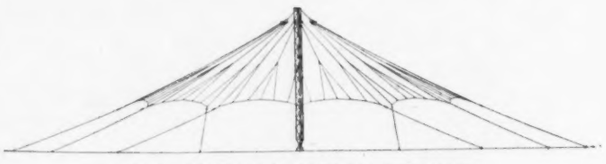


FIG. 2.—DIAGRAM OF GUYS FOR THE TOWER.

part there is a total of 162 cables. The total surface is about 66,000 sq. ft. Each segment of the antenna is connected by means of hemp cords and porcelain nut insulators to a U-iron post rammed into the ground. The leads to the station house consist of 154 cables in the form of six grids held together by wood battens. These pass down from the top of the tower to a bus-bar and then to the station. They are not insulated from the tower, so that the latter forms a part of the oscillating system.

The "earthing" consists of 108 iron wires arranged fanwise in the earth, which spread, in the same manner as the air net, into 324 wires. The earth wires extend over a space of about 1,390,000 sq. ft. At the center they join together and are led from there to the station house.

The operating equipment is housed in a one-story framework building, with an adjoining engine shed. The rooms are so divided that the machine room, telegraph room and receiving or

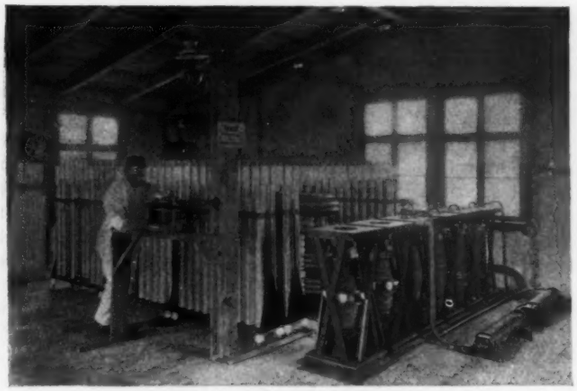


FIG. 3.—TRANSMITTING EQUIPMENT.

sleeping room are on the ground floor. On the first floor is the high-tension room. This arrangement is advantageous in that the sound of the sparking is to a great extent cut off from the telegraph room and above all it affords a dry position and a compact arrangement of the high-tension apparatus.

The source of power is a normal portable steam engine which has an output of about 36 hp. From the fly-wheel of the engine are belted a single-phase alternator and a direct-connected exciter. The alternator is a 50-cycle, 25-kw machine. The current

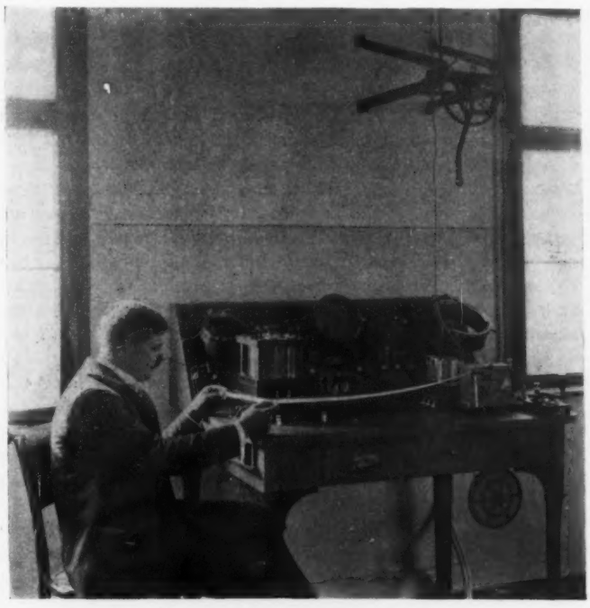


FIG. 4.—RECEIVING EQUIPMENT.

from the alternator is fed through two choke coils to a four-part step-up transformer.

The transmitting equipment consists of a condenser of 360 Leyden jars, a ring-shaped spark-gap without ventilation and a self-induction coil composed of a spiral of silver-plated copper tubing with connections for the exciting circuit and for coupling to the air wire and the earth wire. A permanent connection to an ondometer enables the determination of the length of wave generated.

The jars are charged from the secondary winding of the transformer, to which are connected also a certain inductive reactance coil. By means of exact resonance between the capacity and the inductance at the charging frequency, the condenser can be charged with the expenditure of comparatively little apparent power.

The interruption of the current in the jars is not effected, as in small stations, by opening the primary circuit, but by short-circuiting the primary winding of the transformer, and simultaneously the winding of the generator through the above-mentioned reactance coils. Conversely the Leyden jars are charged by breaking this short-circuit.

Since very powerful currents are employed, a special design of switch was necessary, and this is provided in a transmitting relay operated by means of an ordinary Morse key, which is placed on the receiving table in the telegraphing room.

It is stated that messages have been transmitted from this station 1,500 miles to a ship and 845 miles overland.

Some Points on Illuminating Engineering for the Small Central Station.*

By J. R. CRAVATH.

In a short convention paper of this kind it is manifestly impossible to take up thoroughly even one small branch of illuminating engineering. All that I can, therefore, hope to do in this paper will be to give a few hints of practical value to the central station man as to some of the things to be aimed at and avoided in securing good illuminating results for customers. The awakening to the importance of illuminating engineering during the past eighteen months has been truly remarkable, and has been both a surprise and a gratification to those of us who have made this subject a hobby for several years past. Of all those who should rightly take an interest in securing better illumination for the money expended, central station men have far outnumbered any other class While this fact might seem peculiar to the general public, which erroneously supposes that the central station companies want to get the biggest revenue possible for the least service rendered, it does not seem at all peculiar to those familiar with the broad-minded and progressive men in the central station industry. It is hardly necessary to say that it is recognized by all progressive companies that the securing of better illuminating results for a given expenditure is one of the best means of stimulating the central station business and of meeting the competition of other illuminants.

We are on the eve of a great change in the electric lighting industry. The incandescent lamp in its various new forms is being so enormously increased in efficiency that it promises not only to displace all other electric illuminants for indoor work, but to drive out of use many of the common competing illuminants such as gas and gasoline. Of equal importance with the introduction of higher efficiency lamps is the progress that is being made in the art of getting the most effective illumination from whatever lamps are used.

The two principal points to be borne in mind by those wishing to design good illumination are: First, the blinding effect of lamps placed in the ordinary line of vision, and second, the importance of directing most of the rays of light where they are needed instead of letting them escape in directions where they are useless. The bad effect both on the eyes and on the apparent illumination of a room, when lamps are placed where the eye cannot escape them is probably too well understood by this time to need further explanation. At least, if it is not understood, only a little experiment is needed to make it clear. In connection with the practical application of this point, the problems are confined to locating the lamps so that they will not blind the observers or to covering them with diffusing shades and globes.

* A paper read before the Northwestern Electrical Association Convention at Chicago, Jan. 17, 1907.

The second point, that of directing most of the light in useful directions, makes it necessary to have information at hand on the distribution of light about the different illuminants under consideration when used with the reflectors, shades or globes with which they may be equipped. Here one deals no longer with general principles, but with engineering data on the various appliances. Previous to fifteen months ago exact information on this point was very meager. It is now obtainable in much larger quantities than it was then and within the next few months there will be further important additions to the available literature on the subject. Manufacturers of lamps and glassware are beginning to appreciate the fact that they must furnish photometric curves from some reliable laboratory showing the light distribution about lamps with the various appliances used therewith, if they are to sell their goods to people who are particular as to what illuminating results they get and who take the performance as well as the general appearance of the device into consideration when purchasing.

As information of this kind is all-important to anyone designing illumination, and as one is practically helpless without it unless he can make tests on his own account, and since furthermore the present paper is supposed to give you specific information of practical value rather than "glittering generalities," it is believed that the following list of some of the principal technical books and articles and manufacturers' literature, which contain information of this kind will prove valuable:

"The Art of Illumination," by Dr. Louis Bell, the only book in the language on this subject, is an excellent treatise on the general principles, and contains a considerable number of photometric curves of incandescent lamp reflectors and globes and some data on arc lighting.

A series of articles on "Reflectors, Shades and Globes," run through five issues of the Electrical World and Engineer, beginning November 25, 1905, and ending December 23, 1905, by J. R. Cravath and V. R. Lansingh, gave the light distribution about standard incandescent lamps with about thirty-six representative types of reflectors, shades and globes. An article in the Electrical World of December 1, 1906, by the same authors gave the light distribution about six common types of incandescent clusters and twelve hemispheres or bowls of different types and equipment.

A book entitled "Practical Illumination," by the same authors, now in press and soon to be issued, will contain 122 photometric tests of this kind, including those in the articles just mentioned.

The Transactions of the Illuminating Engineering Society from time to time contain very valuable information along this line and should be in the hands of everyone interested in designing efficient illumination.

The catalogue of the Holophane Glass Company contains photometric curves giving the light distribution about a large number of reflectors and globes made by that company.

The General Electric Company's bulletins on high-efficiency incandescent lamps give the photometric curves of these lamps with various reflectors.

Literature published by the Nernst Lamp Company also gives photometric curves from various sizes of Nernst lamps with different glassware and reflectors.

The catalogue of the Benjamin Electric Manufacturing Company gives photometric curves of some of the clusters made by that company.

The question of the performance of different specific reflectors is one which cannot very well be taken up in a convention paper of this kind, as it is one which consumes time and requires careful study. Anyone designing illuminations must be very familiar with what is obtainable on the market in the way of appliances for changing the natural distribution of light about a lamp. A few general observations are not out of place here, however.

There is as much difference between the different kinds of glassware that may be placed over an incandescent lamp as there is between the performance of a lawn sprinkler and a fire hose nozzle. The performance of a bare incandescent lamp or a lamp placed within an opal, opaline, frosted or pressed glass enclosing globe may be compared to the lawn sprinkler; that is, the light is thrown out in all directions, more being thrown horizontally than any other way. The performance of some of the concentrating conical reflectors either of the opal, prismatic, or mirror types can be compared to the concentrated stream of water from a fire hose nozzle. Each form of light distribution manifestly has its proper place. I am frequently asked what I think of some kind or make of reflector or globe. The answer is nearly always the same: "An excellent thing in its proper place." To be sure, there are few for which the proper place is the scrap pile. Personally, I would place in this latter classification all opaline enclosing globes which, while absorbing considerable light, nevertheless are not sufficiently dense to prevent the lamp filaments showing through with a dull, sickly hue like a red-hot hair pin. They are certainly not ornamental and accomplish only imperfectly the object of softening the light. A dense opal globe is one of the best diffusers, but its absorption of light is high. Frosted or sand blasted and Holophane enclosing globes give excellent diffusion with the lowest possible absorption.

The most generally useful reflectors on the market at the present time are those of opal glass and those of prismatic glass. Opal glass has been known and used as a reflector for many years. Prismatic reflectors have come into use more recently. These two types of reflectors are most generally useful because with them it is possible to throw a certain proportion of the light in the directions where it is most needed, and at the same time some light passes through to illuminate the upper part of the room. It is possible to obtain very similar light distribution effects with opal and prismatic reflectors. At present writing there is this difference, however, that prismatic reflectors have been made in a greater variety of forms and that therefore one can obtain a greater variety of light distribution effects with prismatic than with opal glassware. Opal glassware being an unpatented trade article, there seems not to be the incentive to manufacturers to produce it in shapes scientifically correct that there would be were some one manufacturer putting it forward in competition. The relative appearances of prismatic and opal reflectors, is a matter of personal taste which it is useless to discuss here.

Among the opaque reflectors there are several mirrored types and those of metal either coated or uncoated on the inside. The use of these is confined to places where it is not necessary or desirable to have some light shine through the reflector. A mirrored reflector for most practical uses must either have a corrugated surface or be equipped with a frosted bulb lamp to avoid streaked light. Of the metal reflectors aluminum with frosted finish inside is the most generally useful, as it is easily cleaned inside with sandpaper at any time and the frosted finish makes unnecessary the use of a frosted bulb lamp.

The following are a few practical points of policy and management that can well be observed by central station companies desiring to promote the more efficient use of incandescent lamps on their circuits.

Encourage the installation of lamp sockets pointing straight down, both for chandeliers in residence lighting in the majority of residences and for store lighting. It is frequently difficult to produce good illuminating results with lamp sockets at an angle. With diffusing reflectors too much light will be thrown up toward the ceiling and with concentrating reflectors concentrated beams of light will be thrown out at the various angles at which the lamps point, causing an unpleasantly uneven distribution. In either case the lamp filaments will be visible to anyone within range of the reflector, unless short-lived frosted bulb lamps are used. Furthermore, lamp sockets come to pieces and shade holders sag under the weight of shades at an angle, producing a slovenly appearance. If your company does wiring and sells fixtures, put this rule into practical operation at once. It costs no more to make chande-

liers with pendant sockets than any other way.

Equip every chandelier which goes into the general living room of an ordinary residence with what is frequently termed by fixture makers a "bottom tap," that is, a socket at the bottom of the main stem. There can be used on this bottom tap a reflector which will concentrate light around under the chandelier for reading purposes, leaving the lamps on the fixture arms to be equipped with glassware for the general distribution of light in every direction throughout the room on special occasions.

Do not encourage the erroneous idea that the majority of fancy electric portable lamps are satisfactory reading lamps. This erroneous idea has probably done the electric lighting industry as much damage in residence lighting as any other one mistake in illuminating design. A portable stand lamp with a very deep opal dome shade will give a fairly satisfactory reading light immediately around a small table. Such a dome is not specially ornamental and a light much more satisfactory both for reading and for general illumination can be provided by the proper opal or prismatic reflector placed on the bottom tap of the chandelier, assuming that the readers sit under the chandelier. Furthermore, this chandelier bottom tap lends itself readily to the attachment of a short drop cord on which is arranged a concentrating reflector which can be used for work requiring very intense illumination.

If possible, do not allow any art glass domes to be installed in customers' dining rooms or elsewhere, with the old-fashioned arrangement of a cluster of lamp sockets in the dome pointed at various angles. The lighting within the dome should be done from one socket pointing straight down in which a lamp of any desired candle-power can be used. Over this lamp should be some type of reflector which gives a photometric curve with "ears" on it; that is, it should give more light at an angle of 40 deg. from the vertical than directly underneath, so that the table top will be evenly and efficiently illuminated. Above this one lighting socket in the art glass dome there may be a couple of other sockets for the attachment of electric chafing dishes, etc., but the practice is not at all to be recommended, a new house should always be provided with a separate heating circuit and a floor outlet for the easy connection of heating devices to be used on the dining-room table.

Discourage as far as possible the use of glassware which neither accomplishes the diffusion and softening of the light nor the directing of its rays at useful angles. Some central station companies do not have such control over what is placed on their lines, but in other cases they have almost entire control of the matter. The glassware and fixtures that will be used on new jobs in a town will depend almost entirely on what the company or contractor keeps in stock. It has been observed that a great many of the smaller companies are loaded up with a lot of glassware and fixtures which are not at all likely to be conducive to the satisfactory use of electric light. The average customer will take an inefficient device because he can get it at once, rather than wait for something better to be ordered from a distant supply house. To him one is just about as good as another.

Discourage the use of large chandeliers with small lamps, except possible as a decorative feature. The new large high efficiency units placed either alone or in clusters of two or three will give much better results.

Except where the color of the arc lamp is desired, incandescent clusters using high efficiency lamps of the same wattage as the arc will give better illuminating results than the ordinary arc, and will be free from the great variations common with arc lamps.

Do not use the new high efficiency incandescent lamps of 100 watts and over without having the bulbs two-thirds frosted for the concentrating and distributing reflectors and frosted on the tip with the new bowl reflectors. These lamp filaments are too large and the light too intense to be exposed, without some method of diffusion for the protection of the eye.

Some Phases of Smaller Central Station Management.

In a paper presented at the Chicago meeting of the Northwestern Electrical Association, Mr. H. H. Scott brought out a number of principles which are too commonly lost sight of. The following is an abstract of some of the chief points brought out:

An energetic manager considers it part of his work in every possible way to educate the public to all means and ways whereby the service may be better and more fully supply their wants. And it is doubtless true that the larger percentage of the business of progressive stations is the business thus sought, while the smaller percentage comes of its own accord.

One of the primary principles underlying such a transposition is the endeavor to make every dollar invested in equipment do the utmost work during the year; in other words, produce the greatest number of kilowatt-hours per kilowatt of capacity of machinery in the plant and the maximum gross income per dollar of investment.

To bring this about the manager of any central station has two general subjects to deal with, namely, the physical department and the commercial department.

PHYSICAL DEPARTMENT.

The physical department is concerned with the production and distribution of the means for light, heat and power.

Under this heading there are, therefore, the following subdivisions:

1. Station investment, maintenance and operation.
2. Distribution, investment, maintenance and operation.

The production problem is primarily an investment and secondarily an operative problem. The aim should be to install that character of equipment which will produce the output necessary at the minimum total cost. This total cost is composed of fixed charges on the equipment installed and, operating expenses and maintenance of this equipment.

Unless proper care is given to obtaining the most economical balance between charges on investment made in equipment and the operating expenses, it is very easy to have these investment charges exceed all reason. For instance, in the design of a new station, the most highly efficient prime movers and generating equipment should be installed to supply the constant load, as the load factor on this section of the generating plant is very high. On the other hand the equipment installed to meeet the peak should be at as low in investment cost as possible because its load factor is very low and therefore its charges are of greater importance than its operating expenses.

Following this line of thought, old equipment now installed should be discarded only after the most careful consideration, for while the operating expenses per kw-hour output may be high, the investment charges per kw capacity are low, while the replacement of it means double investment. This, therefore, may often be used with the utmost total economy to meet only an occasional peak.

With reference to the peak it has been very interesting to estimate in a number of instances the total cost of the high peaks during a few days in December or January. This load necessitates a capacity from which only very few kw-hours output per annum are produced, but these kw-hours, though few in number, bear really the total cost of all the charges caused by necessary investments in the equipment required to sustain the peak load.

On the other hand the extensions necessary to meet added loads should be of the highest and most efficient grade of apparatus, which apparatus should be used as continuously as possible to serve the constant load at a high load factor while the old equipment is relegated to meet occasional extraordinary demands which produce a peak load.

The line of thought and analysis suggested in the foregoing consideration of the investments and equipment of a central station should also be applied to its operation. It has been

the experience of the writer frequently to find that in many central stations the units installed are operated in a routine way without studying the varying conditions and operation of each under the most advantageous load of each individual prime mover.

For the development of the highest efficiency in an existing station, curves of at least characteristic days should be plotted for the total load, and the load carried by each prime mover; these curves should be carefully analyzed with the object of consolidating the load on to each prime mover in order that it may be operated as fully loaded as possible at all times. The writer has frequently found instances where this has not been done; for instance, curves plotted along the lines indicated resulted in a saving of 20 per cent in fuel costs of a station with which the writer is acquainted. This economy had not seemed possible to the chief engineer of the plant until he saw the curves, when it immediately became apparent to him without further suggestion.

The problem of distribution is to install such an equipment as will convey the energy generated at the station to the individual customers at the minimum total cost. This problem, like that of the generating station, involves the accurate balancing of investments and their charges against operating and maintenance expenses.

If voltage can be boosted or regulated, it is not a good policy to install sufficient copper to carry an occasional peak with a minimum drop, for then the load factor on the wires is small and comes under the same load factor laws as above suggested for base load and peak load generation.

These statements are an attempt to emphasize basic laws, which in many instances seem to have been overlooked, as evidenced by the fact that some central stations, for instance with, say a No. 1 feeder adopt 50 amperes as the maximum current to be carried on that feeder, while others transmit as much as 200 amperes or more.

A striking example came up in a station where it was proposed to install two additional primary feeders at a cost of $3,000, where an analysis showed that the saving resulting from the additional feeders in copper losses amounted to $7 per annum, and the installation of two circuit regulators installed complete at a cost of $600 produced the same improvement in regulation. Seven dollars would have proven a very small interest on the $2,400, which was the difference in investment to produce the same result.

Transformer core losses and meter shunt losses should receive the same careful consideration. The cost of the transformer losses (the actual operating generating cost) should be less than the interest on the investment for copper to deliver proper service at the consumer's premises.

Pains should be exercised in selecting meters; in so far as possible standard makes and standard sizes should be adopted, for other things being equal the maximum overload capacity of any given make of meter should be of primary importance. The occasional loss of a meter would be many times paid for in the savings in investment and resultant charges.

It is more important to actually measure the energy used at normal or base loads by a customer, than to have the meter register with the minimum of loss on occasional certain infrequent peak loads.

COMMERCIAL DEPARTMENT.

It is beyond the purpose of this paper to consider in detail the many questions arising in the statistical department, in accounting, in the general treatment of the public, and in new business department. It would, however, seem to be appropriate to point out that the refinement of investment and operation of the generating station and distribution system cannot be worked out without the greatest efficiency in net terms, unless the statistics and accounts of the property are so analyzed and segregated as to furnish the necessary information.

The carrying of detailed analytical and statistical accounts is, in fact, the only sound and enduring defense which the manager of the central station property has against unjust rate regulation, both as to prices and forms of rates. It is not generally realized that certain energy demands by the public may cost the central station more than a dollar per kw-hour, while others may cost only a small portion of a dollar per kw-hour. Facts like these come to light only after detailed analyses of the conditions involved.

As an illustration of the conclusions which may be derived from careful considerations of cost, assume a demand for reduction in the price per arc lamp at the expiration of a contract with the municipality. This is a condition which every central station manager has to experience periodically. The officials of the city compare the rates per lamp with those of other similar cities, and do not take into consideration real factors of cost. Assume the number of lamps to be 100 and the price which had been received was $90 per lamp per annum, and the demand was made for an $80 rate, it would be more advantageous and possibly create a more favorable feeling for the company to offer 120 lamps for $9,000, which is at the rate of $75 per annum, than to reduce the price of the 100 lamps to $80 per lamp.

Without going into the almost endless details of new business development, it may be said that there are two extreme ways of operating the sales end of an electric light company, one is to generate and distribute whatever electricity may be called for and to let increase or decrease in sales go as it will without thought or attention.

However, the great attention recently given at all association meetings to sales or new business work shows that this attitude is one of the past, at least among the progressive companies. By these companies it is realized that sales can be scientifically developed. Short hour burning or low load factor business can be avoided. Long hour burning high load factor business can be sought out and developed. Such results are nothing short of revolutionary in their effect upon the operating conditions of an electric light company. The plant load curve, instead of having a needle peak, will more nearly approach a constant full load. Every dollar invested will then begin to result in the maximum physical and financial business possible during the year.

As a suggestion of the effect that this will produce upon the gross, and especially the net, earnings from a station, it is not necessary to do more than point out that all additional sales that are effected without increase in the peak are free of investment charges and do not even bear their pro rata of additional operating expenses.

By thus increasing the load factor and approaching the maximum quantity output of which a plant is capable, economies in fixed charges and operating expenses per kw-hour of output can be effected to a larger extent than by any other means now known. If this development is conducted on tried and proven lines, increases in gross and net earnings, and decreases in average and individual rates can be brought about, which otherwise would be unattainable. By so doing drastic rate regulation, competition, and Municipal Ownership can be silenced in the most effective manner, which is by the company's furnishing a better, greater and cheaper service than would be possible for others to do.

In addition to the engineering, managerial and commercial ability necessary to handle the problems above suggested, an extremely important factor is the company's relations with the public it is serving. The best salesmen we can have are customers who appreciate our service. The public will never appreciate our service unless they are made to realize that we are using every effort to serve them as well and as cheaply as possible. If a realization of this can be brought about in most situations as it has been in some, a degree of prosperity and security now beyond our hopes will ensue, but to this end the public must be brought to realize that the electric lighting company is its sincere and willing servant. To this end no pains should be spared on the part of every employee of a company, and especially of those who come in frequent contact with the public, as telephone operator, application clerks, collectors, and

so forth, to make the public realize that such is the company's attitude toward it.

DISCUSSION.

Mr. W. B. Jackson said that there had been almost a craze for throwing out old apparatus and substituting new several years ago, and that in some cases this had been a mistake. He called special attention to the fact that good management can frequently make a very poor plant pay, whereas poor management can almost never make a good plant pay.

Mr. Ernest Gonzenbach cited a case where the management of a plant had been criticised for putting in a cheap high-speed engine and generator for carrying its peak loads. As a matter of fact, the peak load could be carried more economically by that cheap engine than by anything else. Referring to that part of the paper by Mr. Scott on relations with the public, he told of a move he had made in Sheboygan in December which seemed to take very well with the public. He sent out 1,000 aluminum whisk broom holders advertising electric light. These were of a quality which would usually retail at about 50 cents each. These he thought had a decidedly beneficial effect in smoothing out the "December lighting kicks," December bills always being the highest and complaints being the most frequent in that month.

President Almert said that last year at this convention he had been one of the participants in a lively discussion over the question of the advisability of throwing out antiquated apparatus, in which he had favored the purchase of up-to-date machinery and of relegating high-frequency, alternating apparatus to the scrap pile. He agreed with Mr. Scott as to the advisability of keeping old engines and boilers for carrying peak loads, but on the distributing system the core losses of old transformers and shunt losses of old meters 24 hours a day made a hole in the profits.

Mr. J. H. Harding reiterated a statement made last year that for the particular conditions in his plant where there was but little power business in alternating-current districts he was better off with high-frequency than with low-frequency apparatus. His transformer core losses were lower and he could easily obtain high-frequency, single-phase motors for what little power business there was. As a demonstration of the financial soundness of his position, he said that several years ago when they wished to enlarge the plant he purchased a practically new 300-kw direct-connected, high-frequency alternator running 80 r.p.m. for $2,200. When it came to the purchase of motors for customers he could obtain high-frequency, single-phase motors which had been discarded in other cities where the change to lower frequency was being made. In answer to a question he said that 7½ hp was the largest single-phase motor they would take on their lines, larger motors causing too much line disturbance.

Mr. Scott said that the interest on the machinery investment needed to carry the top of the December peak would frequently bring the cost per kw-hour for the last few kilowatts up to $5. Referring again to the question of handling the public, one of the most remarkably successful managers he ever knew made it a point to answer himself all telephone calls which came in during the peak load, so important did he consider the matter of seeing that complaints and emergencies were properly attended to. Mr. Scott favored the adoption of some standard size of meter (5 or 10 amp.) to be used throughout the residence district without regard to the number of lamps installed by each customer. This statement was evidently received with surprise by many members and Mr. Scott was questioned as to the ability of a 5 or 10-amp. meter, to carry the load found in some residences. Mr. Scott said that the overload capacity of a good meter should be about 600 per cent for one hour.

Mr. Rau said that the general policy of his company was to install 10-amp. meters in a residence district. In one case which occurred recently, however, where a meter was burned out in the midst of a social function being given by a prominent citizen, they would have been willing to pay for a good deal of additional capacity in meters rather than have the interruption to service occur when it did in this case.

New Telephone Patents.

TRANSMITTER.

A transmitter in which the diaphragm is clamped free from contact with the face of the casing forms the subject of a patent granted to A. Larson, of Buffalo, N. Y. A spring split ring snapped into a beveled groove in the body of the casing clamps the diaphragm down. An auxiliary tin-foil diaphragm stretched over the ring protects the main diaphragm from moisture.

AUTOMATIC SYSTEM.

G. A. Betulander, of Stockholm, Sweden, has obtained a patent for an automatic system. This embraces the usual complicated circuits for testing, switching and signaling, and also the novel idea of a machine, the mechanical part of which may be removed as a unit without disturbing the wiring.

LETTERS TO THE EDITORS.

Space Telegraphy.

To the Editors of Electrical World:

SIRS:—Referring to the letter of Mr. Robert K. Howard, published in the ELECTRICAL WORLD, January 12, in which he suggests the term "ether telegraph" as a substitute for "wireless telegraphy," why not use the term "space telegraphy"? It is already used to some extent.

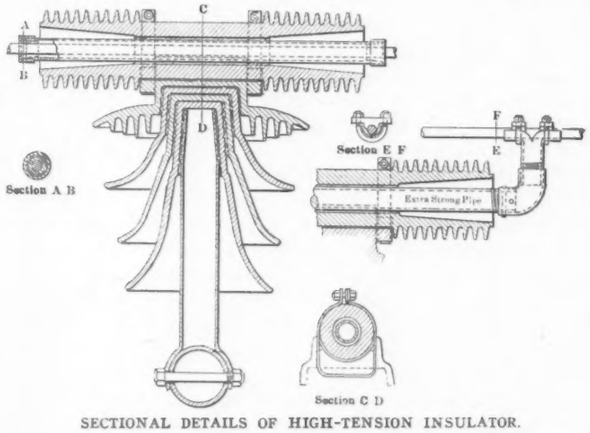
NEW YORK. CHARLES R. UNDERHILL.

High-Tension Insulator.

To the Editors of Electrical World:

SIRS:—The drawing which you published on December 22 of an insulator, on which patent was granted to me December 11, 1906, was made up two years ago largely for the patent application. The accompanying drawing shows the insulator as recently designed.

Instead of the insulator top having projecting porcelain lugs around which go the bands securing the bushing, we may use a metal ring cemented over the top of the insulator, the metal ring having projecting lugs for securing the bushing to the top



SECTIONAL DETAILS OF HIGH-TENSION INSULATOR.

of the insulator by means of the bands. When the line is first strung it may be threaded through the bushing as shown in the upper figure, but should an insulator be broken repairs may be made as shown below without cutting the line, if this is not desirable.

This design of an insulator has been worked out for an operating voltage of from 80,000 to 100,000 volts after an experience of several years with all kinds of insulators under all kinds of conditions. It is believed that the design is logical, and one which would be arrived at by considering the subject from the mechanical as well as the electrical standpoint. It is the opinion

of a large number of engineers that power will be transmitted within the next five years successfully at 100,000 volts, and I believe the design given will operate at that voltage, except where fog conditions are extremely severe. It is hoped that the design offered will bring out other ideas on the matter.

San Francisco, Cal. F. G. Baum.

DIGEST OF CURRENT ELECTRICAL LITERATURE

Dynamos, Motors and Transformers.

Rectifying Alternating Current.—Wehnelt.—A description of an electric valve for transforming single-phase and polyphase alternating currents into pulsating direct current. The action of the valve is based on the property of incandescent metallic oxides to diminish very considerably or annihilate completely the cathode drop in vacuum tubes. Fig. 1 shows the latest

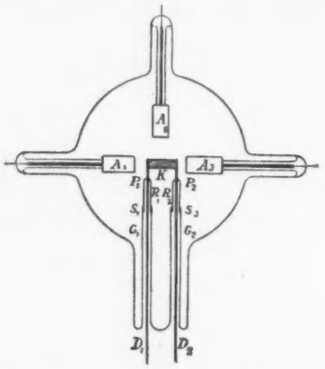


Fig. 1.—Alternating-current rectifier.

arrangement of the valve. A glass globe 12 cm. in diameter contains three anodes, A_1, A_2 and A_3, in the form of strong, bright steel rods (length 10 cm., thickness 0.5 cm.). The cathode, K, consists of a platinum sheet 4 cm. in length, 1 cm. in width and 0.003 cm. in thickness. It therefore has a surface of 8 sq. cm. It is covered with a suitable mixture of oxides, the most active of which are those of barium, strontium and calcium. The sheet is fixed at two strong copper wires, D_1 and D_2, through which passes the current which heats the cathode. This current is supplied from a small transformer or from a storage battery. Since copper wires cannot be properly fused in glass the two platinum tubes, R_1 and R_2, are fused into the glass and in these the copper wires are inserted as shown in the illustration. As high a vacuum as possible should be employed. In experiments with such a valve the oxide cathode was heated electrically to about 1,300° C. from several large accumulators. Eighty watts were required to maintain the cathode at this temperature; that is, 10 watts per square centimeter of incandescent surface. When the three anodes, A_1, A_2 and A_3, were connected together to form a single one and direct current at 110 volts was sent through the valve the discharge potential was always the same and amounted to 19 volts for all currents from 0.1 to 20 amp. With currents of 10 amp. or more the anodes became heated quickly and disintegrated so that with currents of this strength stronger steel anodes should be used. For getting pulsating direct current from three-phase currents the three anodes of the valve are connected with the three phases of a three-phase transformer and the incandescent cathode with the neutral point through a resistance. Pulsating current then passes through the latter. It is always above zero and is stated to be very well adapted for operating direct-current lamps from three-phase systems. For the charging of accumulators from alternating-current systems the efficiency of the valve is thought to be as good as that of small motor-generators. To make a good electric valve highest cleanliness is of the greatest importance. Even very small traces of hydrocarbons (resulting from fat or oil) in the tube result in the decomposition of the oxides with the formation of carbides.—*Elek. Zeit.*, January 3.

Alternating-Current Armature Windings.—Hobart and Ellis.—The first part of an illustrated serial on alternating-current armature windings and their classification. The authors first consider the derivation of single-phase windings and define the fundamental terms—coil, single coil and multicoil. Multicoil windings are those where the coil is distributed over a number of slots greater than unity; thus the term triple coil designates that the coil is divided into three parts, each part occupying a single pair of slots. The authors then distinguish between whole coil and half coil windings. Whole coil windings have one coil per phase per pole. Half coil windings have one coil per phase per pair of poles. A distinction is finally made between lap coils and spiral coils. The serial is to be continued.—Lond. *Elec.*, January 4.

Calculation of the E.M.F. of Single-Phase and Polyphase Windings.—Goerges.—A mathematical paper in which the author gives a vector diagram of the magnetomotive force which shows at once the shape of the magnetic field produced in any moment by a polyphase winding. This diagram permits the graphical determination of the total magnetic flux at any moment, and simple formulas are derived for its calculation. The diagram is a safe foundation for the calculation of the e.m.f., which is generated by its own current in a polyphase winding with any number of slots (that is the total e.m.f. of self-induction). The diagram also gives information on the stray field. The results obtained for polyphase motors may easily be applied to single-phase motors.—*Elek. Zeit.*, January 3.

Single-Phase Commutator Motors.—Richter.—A long communication replying in detail to the criticisms of Eichberg on the series single-phase motor of the Siemens-Schuckert Company.—*Elek. Zeit.*, January 3.

Three-Phase Generator for Direct Coupling with Steam Turbines.—Kolben.—An illustrated article giving mechanical and electrical details of the construction and design of a turbo-alternator built for a normal capacity of 970 kilovolt-amp. (about 1,400 hp for unity power factor), the voltage being 450 and the intensity of the three-phase currents 1,246 amp. per phase, the speed 1,500 r.p.m. and the frequency 50.—*Elek. und Masch.*, January 6.

Synchronous Motor.—Tatlow.—An article giving simple graphical solutions of some synchronous motor problems.—Lond. *Elec. Rev.*, January 4.

Power.

Electric Power in a Flour Mill.—An illustrated description of the electric equipment of the large Dunston-on-Tyne flour mill, where it was found worth while to discard a modern first-class steam plant and to substitute electric driving. The chief advantages are greater cleanliness, which is of the highest importance for the treatment of flour, and lower cost of working. Three-phase currents at 6,000 volts are supplied from a power company to the sub-station on the mill premises where they are transformed down to 440 volts at 40 periods, being then led to the various departments of the mill. Squirrel-cage induction motors are used.—Lond. *Elec., Elec. Eng.*, January 4.

Traction.

Single-Phase Traction.—The first part of a review of the different single-phase roads now in operation. First those in Europe are reviewed. There are the Stubai Valley Road in Tyrol; operation began in August, 1904; built by Allgem. Elek.

Ges. and Union Elek. Ges. in Vienna; length, 18.2 km.; each motor car has four Winter-Eichberg motors. The Murnau-Oberammergau Road in upper Bavaria began operation in January, 1905; built by the Siemens-Schuckert Company; length, 23.6 km.; each motor car has two series motors of 80 hp. The Borinage roads of the Chemins de Fer Vicinaux in Belgium began operation in April, 1905; built by Allgem. Elek. Ges.; length, 20.85 km.; each motor car has two 40-hp Winter-Eichberg motors. The Oerlikon-Seebach-Wettingen road near Zurich, Switzerland, began operation in 1906; built by the Oerlikon Company; length, 19.5 km.; the double-truck locomotive is provided with a compensated series motor on each truck. The Rome-Civita Castellana Road is in course of construction; built by the Italian Westinghouse Company; length, 54 km.; each double-truck motor car has two 40-hp series motors. The Bergamo-Valle Brembana Road, in course of construction; built by the Italian Westinghouse Company; length, 30 km.; the locomotives are provided with series motors of 75 hp. The Vienna-Baden Road is a combined direct-current and single-phase road; began operation in the winter of 1906; built by the Austrian Siemens-Schuckert Company; total length, 20 km., of which 6.3 km. are in Vienna and in Baden and are operated by direct current, while the balance is operated by single-phase current; each double-truck motor car is provided with four 50-hp series motors; series parallel control and resistances are used on the direct-current parts of the line and a six-step transformer on the single-phase line. The Blankenese-Ohlsdorf Road, near Hamburg, will begin operation in the spring of 1907; built by Allgem. Elek. Ges. (equipment of cars), and Siemens-Schuckert Company (power station and line); the two trucks of the motor cars are equipped one with two motors of 110 hp, the other with one motor of the same size. Then follows a review of American single-phase roads, giving details on the Indianapolis-Rushville, the Atlanta-Marietta and the Long Island line, built by the Westinghouse Company, and of the Schenectady-Ballston line and the Pontiac-Odell line, built by the General Electric Company. The article is to be continued.—*Elek. Zeit.*, January 3.

Three-Wire System for Traction.—A note on the possibility of considerably extending the sphere of untransformed direct current for traction purposes by means of the three-wire system. This scheme has, for instance, been applied by the City and South London Railway. A pressure of 2,000 volts is there employed, but this voltage is used only for running motor-generators at the far end of the line, and the pressure on the system as a three-wire system amounts to only 1,000 volts; that is, 500 volts on either side, the track rails forming the neutral. The pressure on the motors being only 500 volts, the usual series parallel control can be adopted. On the Metropolitan Railway at Vienna the pressure across the outers is 3,000 volts; that is, 1,500 volts between each outer and the track rails. Each locomotive has four motors, which are being coupled permanently in series. In starting the four motors are connected between one outer and earth and when half speed has been reached they are placed between the two outers, the mid-point between the motors being then earthed. This method has the advantage of simplicity and no such complete breaking of the circuit is necessary as is the case in passing from series to parallel in the ordinary form of control. The same issue contains an illustrated description of this Vienna road, which has been noticed repeatedly in the Digest.—Lond. *Elec.*, January 4.

London Subway.—A fully-illustrated description of the Great Northern, Piccadilly & Brompton Railway. It is a tube road with third-rail equipment.—Lond. *Elec. Rev.*, January 4.

Installations, Systems and Appliances.

British Central Station Statistics.—The annual statistical tables of British central stations giving a vast amount of information on the history, equipment, etc., of all stations without traction load. The number of entries is 275, as compared with 267 last year. The small increase shows that the curve of increase is reaching the point of saturation. There has been a considerable increase in motor connections, this being the more particularly noticeable in the provinces rather than in London. The motor load naturally depends very much upon the character of the town. Thus Dublin, which is an industrial city to some extent, with a population of 291,000, has only 400 hp of motors and 128,000 lamps of 8 cp on its alternating-current mains, the rate for electricity being 6 cents and 2 cents per kw-hour. Coventry, on the other hand, which is essentially a manufacturing town, but with a population of only 85,000, also with an alternating-current supply, claims 2,346 hp of motors and 127,000 lamps of 8 cp. Most towns now offer a flat rate as an alternative to some form of maximum demand, and there has been a general reduction in price for both lighting and power. In London Bermondsey supplies electricity for light at 7½ cents, Fulham and Islington at 7 cents and Hammersmith at the low price of 6 cents; many of the London councils and companies now supply energy for motor power at about 2 cents per kw-hour. Among the projected stations it is noticeable that a large number are preparing to take electricity in bulk instead of generating for themselves.—Lond. *Elec.*, January 4.

Electro-Physics and Magnetism.

Ultra-Violet Light.—MILLIKAN AND WINCHESTER.—An account of an investigation of the discharge of electrons from ordinary metals under the influence of ultra-violet light. The authors found that the effect is wholly independent of the temperature. They then determined the order in which the common metals arrange themselves in relation to their power of emitting electrons under the influence of a given source of ultra-violet light. They also determined the relative velocities of projection of electrons from the various metals by measuring the positive potentials acquired by them under the influence of ultra-violet light. These potentials were found to be in all cases wholly independent of temperature—a fact which appears to warrant the conclusion that the kinetic energy of an electron within the atom of which it forms a part is not influenced by the temperature changes.—*Phys. Rev.*, January.

Ionization.—DAVIS.—A mathematical paper on the energy necessary to ionize a molecule by impact of negative ions.—*Phys. Rev.*, January.

Electro-Chemistry and Batteries.

Manufacture of Ferro-Alloys in Electric Furnace.—HUTTON.—An illustrated description of the Girod ferro-alloy works in France and Switzerland. The company has three electric furnace plants and produces per year some 9,000 tons of ferro-alloys (of which 5,000 tons are ferro-silicon, 50 per cent), with a total value of over $1,800,000. Analyses of some of the typical products of the plant are given. The new electric steel furnace of Girod is also described. The process of treatment is in general similar to that adopted by Héroult.—*Electrochemical and Met. Ind.*, January.

Units, Measurements and Instruments.

Rotary Interrupter for Capacity Measurements.—KURLBAUM AND JAEGER.—A description of a rotary interrupter for high frequencies constructed in accordance with the well-known principles of the secohm meter and used for some time in the Reichsanstalt for absolute measurements of capacity and other tests. The elevation, plan and section of the instrument are shown in Fig. 2. The interrupter consists of two brass plates separated by an ebonite plate, *e*. The sectors are cut out of the brass and replaced by ebonite sectors, *s s*, fastened with three screws each. The copper contact brushes, $f_1 f_2$, alternately touch the ebonite pieces and the brass pieces, *m*, remaining between them. The latter are in metallic contact with the contacts, f_3 and f_4, which slide on the brass plates near the shaft. Of the bits, *b*, one is soldered while the other is a nut screwing on to the shaft and pressing the discs against the soldered bit. The shaft projects beyond both bearings and is provided at one end with a pulley, *u*, and at the other with a worm wheel, *r*, which drives the counting device. The pins on the rim of the wheel, r_2, serve

in the well-known manner for making contact with the spring, *l*, which can be shifted along the rod, *t*. The pins have various lengths, thus enabling one to use one or more of them, according to the frequency. This is regulated by displacing the spring along the rod. At every revolution of the disc the contacts are interrupted 30 times. For capacity measurements it is essential that the speed be constant, so that the galvanometer needle may be stationary. When there is a good and steady series of

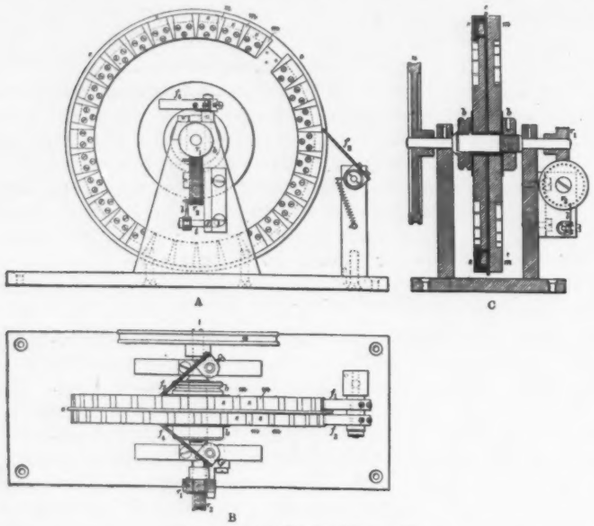


FIG. 2.—ROTARY INTERRUPTER.

contacts Heydweiller's method for measuring inductances may be employed. The authors quote as an example of the precision of the instrument the measurement of the capacity of an air condenser of about 0.002 mf. Those measurements, taken with 80, 590 and 1,120 interruptions per second, respectively, showed differences not exceeding one-hundredth per cent. The polarization in cells through which a current is passed may be measured by means of this instrument to within a hundred-thousandth of a volt.—From *Zeit. f. Instrumentenkund*, November; translated in Lond. *Elec.*, January 4.

Electric Measurement of Brief Intervals of Time.—Devaux-Charbonnel.—From the theory of the charge and discharge of condensers it follows that the measurement of the charge at two different moments permits one to calculate the time between these two moments. The author describes a plan for measuring the time of the fall of a body between the moments when it encounters two levers in its way. The arrangement is shown in Fig. 3. Two levers, *A* and *B*, which the moving body releases

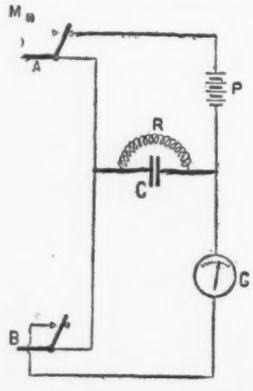


FIG. 3.—ELECTRIC MEASUREMENTS.

in its fall, are connected to one another and to one side of the condenser, *C*, shunted by the resistance, *R*. The other side of the condenser is connected to the negative terminal of the ballistic galvanometer, *G*, and to one pole of a battery, *P*. The second pole of *P* is united to the abutment stop of *A* and the positive terminal of the galvanometer, *G*, to the impact stop, *B*. The moving body, *M*, in falling sets *A* in motion. At that moment the connection of the condenser and the battery will be broken and the condenser will discharge across the resistance, *R*. When the moving body meets *B* the lever will fall on its impact stop, permitting the condenser in this way to discharge across the galvanometer, *G*. In order that, during this discharge, we may neglect the quantity of electricity which continues to pass across the resistance, *R*, it will be adequate to make the resistance of the galvanometer sufficiently small with respect to *R*, a condition which it is always easy to realize. The method enables one to measure without difficulty a ten-thousandth of a second.—Lond. *Elec. Rev.*, January 4.

Measuring the Capacity of Power Transmission Cables.—Akemann.—That capacity of a conductor in a multiple cable from which the charging current of the conductor can be directly calculated for a given potential and frequency is called the "effective capacity." The author discusses the determination of the effective capacity of power transmission cables provided with testing wires. In any case two measurements are necessary. The best procedure for different types of cables is discussed and formulas are given.—*Elek. Zeit.*, January 3.

Measurements of Inductance and Impedance.—Young.—The conclusion of his paper on the measurement of inductance and impedance of telegraph and telephone circuits, including overhead wires, cables, etc. The author discusses the effect of iron, its permeability, the eddies generated in it and its residual magnetism on the measurements. After a brief note on testing coiled and suspended cables he discusses at greater length the measurement of the sending-end impedance and of the receiving-end impedance. The article is illustrated by diagrams.—Lond. *Elec.*, January 4.

Power Measurement.—A summary of the different methods for measuring power in three-phase systems. The description, which is concise, is illustrated by diagrams.—*Elek. und Masch.*, January 6.

Telegraphy, Telephony and Signals.

Electrolytic Wave Detector.—Armagnat.—The action of the electrolytic wave detector or barreter depends on the fact that when a battery furnishing a small e.m.f. is connected so as to send a current from the smaller to the larger electrode in the electrolytic detector the current is very feeble, unless electric

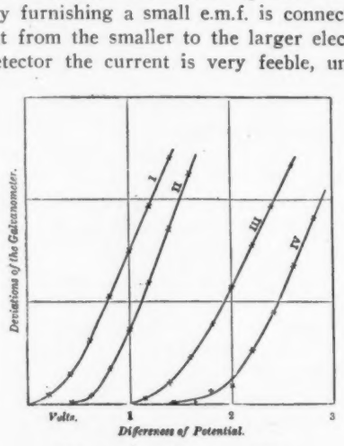


FIG. 4.—VOLTAGE CURVES.

waves are passing. The latter apparently tear up the polarization layer at the small electrode and enable the current to pass freely. The author determined the "critical tension" of such a detector or electrolytic condenser by placing it in circuit with a galvanometer and a potentiometer, so that the e.m.f. applied to the circuit could be altered at will. The currents thus obtained are shown in terms of the e.m.f. for four different detectors in Fig. 4. Curve I was formed of platinum wires immersed in a mixture of potassium bichromate and dilute sulphuric acid. If the diameter of the anode wire is reduced from 0.5 mm. to 0.1 mm. the critical tension is increased, as shown in curve II. On further substituting sulphuric acid of density

1.25 for the former electrolyte, curve III is obtained; if, with the new electrolyte both wires are given a diameter of 0.1 mm., curve IV is obtained. To obtain concordant results a resistance of 300,000 ohms must be inserted in the circuit. The currents amount to only a few micro-amperes. In all curves except I there is no current until a minimum e.m.f. has been passed. Maximum sensitiveness is attained if this minimum e.m.f. is slightly less than the e.m.f. of the auxiliary cell. The electrolytic detector furnishes a very convenient means for detecting very small alternating differences of potential, and Ferrié and Carpentier have thought of applying it to all null methods for measuring polarizable resistances, small inductances, small capacities and the like.—Lond. *Elec.*, January 4.

Automatic System of Electric Signaling for Railways.—BROWN.—An illustrated paper read before the British Inst. Elec. Eng. on the use of the track circuit for an automatic system of electric signaling on existing steam railways. A battery is connected between the two rails and also a relay, which is short-circuited by the passage of a train. Calculations are given showing the relation between the resistance of the relay, the rails and of the ballasts.—Lond. *Elec.*, January 4.

Independent Telephony.—HOGE.—A Franklin Institute paper giving a historical sketch of the development of the American Bell Telephone Company and of the independent telephone systems.—*Jour. Franklin Inst.*, January.

Railway Signals.—WILLSON.—The first part of an illustrated serial on railway signalling. The present installment deals with mechanical interlocking systems.—*Elec. Jour.*, January.

Signalling in Mines.—WOLFF.—The electric signal transmission system of Siemens & Halske for use on board ship has been so modified as to be especially adapted for use in mines. The installation of this system in a mine in Silesia is described and illustrated.—*Glückauf*, December 29.

Miscellaneous.

Convention of Swiss Electrical Engineers.—A report of the joint convention of the Swiss Electrical Society, the Association of Swiss Electricity Works and the Incandescent Lamp Buying Bureau of this Association. The Convention was held in Bern last autumn. A report was presented on the co-operation of the Association with the government in working out regulations for the installation and maintenance of electric power plants. The Association protested against the eight-hour day for workingmen in power plants. The Incandescent Lamp Buying Bureau has sold, during the last year, 384,322 incandescent lamps to different plants. Half of the profit was placed at the disposal of the Material Testing Bureau for the purpose of improving its photometer equipment. This Material Testing Bureau was instructed to periodically test and examine the photometric equipment of the different lamp manufacturers. The result of this control has been that at the end of the year an appreciable improvement in the quality of the incandescent lamps took place. In the tests of 5,152 incandescent lamps made by the Material Testing Bureau, 25 per cent were found not to have the proper voltage and 48 per cent to consume more than the proper watts per cp. In a report on the development of the metallic filament lamp this is considered as the electric lamp of the future. A review is given of the work of the Material Testing Bureau and sketches are added of the electric plants of the city of Bern and of the hydro-electric Kander plant which were visited during the convention.—*Elek. Zeit.*, January 10.

Expiration of Patents.—A list of the more interesting of those electrical patents which are to expire in 1907. Among them is the Siemens-Obach patent for the Obach dry cell, a patent by Sayers for overcoming armature reaction by means of special coils independent of the main winding, a patent of Hutin and Le Blanc for preventing eddy currents in the non-laminated field poles of dynamos, by placing non-magnetic metal rings of low resistance on either side of the pole tips and connecting them together by bolts of the same metal, a patent of Girard and Street for converting amorphous carbon into graphite in the electric furnace and a patent of Hargreaves for his cell for the electrolysis of common salt.—Lond. *Elec.*, January 4.

Manufacturing Plant.—HENNIG.—An illustrated description of the new Werner works of the Siemens & Halske Company in which instruments, telegraphy and telephony apparatus, cables and electrochemical apparatus are manufactured.—*Elek. Zeit.*, January 3.

Canada.—GRAY.—A note on the abundance of water powers in various regions of Canada and the wide possibilities of electrical developments.—*Elec. Jour.*, January.

Exposition.—RUSSMANN.—An illustrated description of gas engines at the Milan Exposition.—*Elek. und Masch.*, January 6.

BOOK REVIEW.

THE ELECTRON THEORY. A Popular Introduction to the New Theory of Electricity and Magnetism. By E. E. Fournier d'Albe. With preface by G. Johnstone Stoney. London: Longmans, Green & Co. 311 pages, 35 figures.

This work on the application of the electron theory to the essential phenomena of electricity and magnetism is written clearly and simply, comparisons and illustrations helping to a conception of the role and potency of the electric atom in the material world. Others have striven to apply these modern views to some of the commoner electrical phenomena; but we know of no one who has succeeded so well in compelling the newest of physical atoms to adapt its behavior to the various conditions of the electric and the magnetic field. It is, indeed, surprising to see the wide range of phenomena in which the tiny electron and its big partner, the positive particle, play a determining and preponderating part, from grandmotherly frictional electricity to the Zeeman effect and radioactivity itself.

Recent speculation embodied in this book is nothing if it is not bold and startling; it shatters into a thousand fragments the atom of the astounded chemist to replace it by the indivisible electron of the triumphant physicist. Most astounding of all is the coolness and complacency with which we are told of the change of one elemental form of matter into another. The mediæval alchemists were not such insane toilers after all, as shown by the statement of Prof. Rutherford on page 266, in which he affirms that there can no longer be any doubt that in the radio-elements "we are witnessing the spontaneous transformation of matter, and that the different products which arise mark the stages as halting places in the process of transformation where the atoms are able to exist for a time before again breaking up into new systems."

Contrast this dogmatic assuredness with the wail of despondency that sounds throughout the following sentence, taken at random, from the address of Prof. Crew before the December meeting of the American Association for the Advancement of Science: "Conceive a single, negatively charged electron—*whatever that may be*—placed inside a mass of positive electrification—*whatever that may be*, etc." And again, "Nor can we hope for any solution which can in any sense be called final; all solutions are mere passing phases."

The contrast between the cock-suredness of the one with the uncertainty and despondency of the other is, to say the least, as perplexing as it is painful.

The author of this "popular" account of the electron theory of matter, the latest, widest and most surprising generalization of science, believes that it affords a better and more rational explanation of electrical phenomena than any hitherto proposed. More time, however, is needed before we can feel satisfied with all the strategical movements attributed to "companies" and "armies" of electrons.

The preface by Dr. G. Johnstone Stoney extends to twenty pages, in which the eminent Irish mathematical physicist calls attention to recent points in the kinetic theory of gases and has something to say about the general shaking up which the chemical molecule has received in recent years.

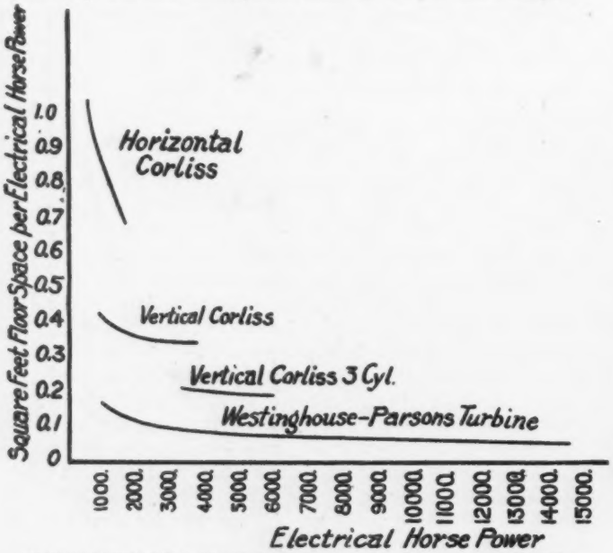
No teacher of physics or chemistry can afford to be without

this book on the electron theory, which is remarkable alike for its lucidity and comprehensiveness.

Large Turbo-Generators for Rapid Transit Work in Brooklyn.

Electric generating units of 10,000 kw capacity, complete in a single machine, have at last become a reality. The introduction of generating machinery of this size has been brought about by the contract recently executed between the Transit Development Company, of Brooklyn, and the Westinghouse Machine Company, of Pittsburg. It is stated that this transaction is distinctive in carrying not only the largest single order ever placed for power generating machinery, but also units of the largest size contemplated at the present time. The new equipment will consist of five 10,000-kw turbo-generator units and a large amount of converting, transformer and controlling apparatus.

In compactness the new unit establishes a new standard. Over-all the turbine measures 24½ ft. in length, 15 ft. in width and 12¼ ft. in height, above the floor level. This is equivalent to 3.8 b.hp (rated) per sq. ft. occupied, or 5⅔ b.hp maximum; conversely the turbine requires .026 sq. ft. per rated b.hp, or .018 sq. ft. per maximum b.hp. The combined unit measures, approximately, 48½ ft. in length, equivalent to .075 sq. ft. per kw rated, or .049 sq. ft. per kw maximum. That a striking advance has been made within recent years toward securing greater compactness in prime-movers is shown by the accompanying curve, and the end is not yet.



COMPARATIVE FLOOR SPACE REQUIRED FOR FOUR TYPES OF PRIME-MOVERS.

The turbine equipment is designed for a steam pressure of 175 lb. at the throttle, 100° superheat and 28 in. vacuum. In the event of loss of vacuum, accidental or otherwise, the turbine will automatically "go to high pressure" carrying its full rated load without the assistance of a condenser. This feature will be obtained through the use of a secondary admission valve, of construction similar to the primary valve, and operated by the governor in such a manner as to automatically come into operation when the overload upon the machine reaches a certain point. The action of this valve is to raise the pressures in the various stages and thus increase the capacity of the machine.

In the construction of the generator the standard rotating field design will be employed with frame entirely enclosed so as to facilitate forced ventilation and incidentally obviate the noise emanating from high-speed turbines. Electricity may be delivered at 6,600 or 11,000 volts, according to the method of connecting the armature windings.

Self-Contained Belted Alternator.

In the alternator illustrated herewith the bearings are supported in end housings bolted to the stator yoke so that the whole machine is self contained. The stator yoke rests on slide rails to which it is bolted. The machine is of the revolving-field type, the armature being stationary. The stator punchings are supported in a cast-iron yoke provided with numerous openings to allow free circulation of air.

All armature coils are form wound. As the slots are open, the coils can be readily removed. The projecting stator yoke and end housings completely protect the ends of the coils where they project beyond the laminated core.

The field poles are built up of steel laminations riveted between end heads and dovetailed and keyed to a spider or hub. The field coils are wound with square wire, which makes a very compact and durable winding. Exciting current is supplied to the field coils through cast bronze collector rings mounted on the shaft between the field core and the outboard bearing. The bearing housing has three arms, as shown in the illustration, thus leaving the space around the collector rings and brushes easily accessible. Each ring is provided with two brushes. The machine illustrated has the shaft extended to receive a pulley for driving a belted exciter. The bearings are of the ring oiling, self-aligning type and are of liberal dimensions. The two bearings are of the same size.

SELF-CONTAINED ALTERNATOR.

This machine is one of a line of alternators recently developed by the Allis-Chalmers Company, Milwaukee, Wis.

Telephones at Automobile Show.

The amount of business done last week at the Automobile Show at Madison Square Garden, New York, and the wonderful activity which centered there, was evidenced by the number of telephones installed in the Garden to facilitate business during the week.

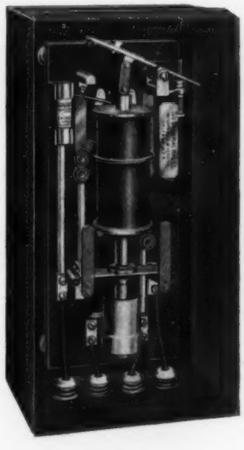
On the main floor over 150 private telephones were installed in the spaces of exhibitors. These telephones were connected to the Madison Square Exchange, where a section of the switchboard was set apart for these automobile show lines. The telephone company printed a special directory of these automobile show numbers, and the directory was sent to all the telephone company's central offices and public pay stations in order that

those desiring to get in touch with exhibitors at the Garden could do so quickly.

In addition to these private telephones, there are two public telephone exchanges in the Garden, with booths and operators, one located in the café just off the main entrance, and one in the rear of the Garden near the Fourth Avenue entrance. The amount of business done by these telephones was shown by the fact that it requires no fewer than 14 operators and attendants to handle it. The rathskeller in the basement was equipped with table telephones, a new style of instrument which the telephone company has recently adopted. The installation of this large system was completed on the opening night of the show, and the service was found most useful.

Universal Flat Rate Controller.

Ever since the beginning of the electric light industry trouble has been experienced by companies who sell electricity at flat rates because customers who contract for a certain number and candle-power of lamps later, without the company's knowledge, increase their installation while still paying the original rate. Various devices have been brought forward to overcome this from time to time, but few of them seem to have survived for any considerable period. The flat rate controller recently brought out by the Universal Manufacturing Company, 206 East Illinois Street, Chicago, has in its design some interesting principles which seem to indicate that it will prove satisfactory in service. The action of the device when connected in series with an installation of lamps is to interrupt the circuit at intervals of a few seconds whenever the maximum demand for which the customer contracts is exceeded by as much as one 4-cp lamp. Referring to the illustration of the device, the central solenoid consists of two coils, each acting on a separate plunger. One of these coils is in series with the lamps all the time. Whenever the current exceeds the amount for which the device is set, the top coil pulls down the pivoted armature to which the upper end of the solenoid plunger is attached, which acts as a relay to make contact and establish a circuit through the lower solenoid. The lower solenoid draws up a

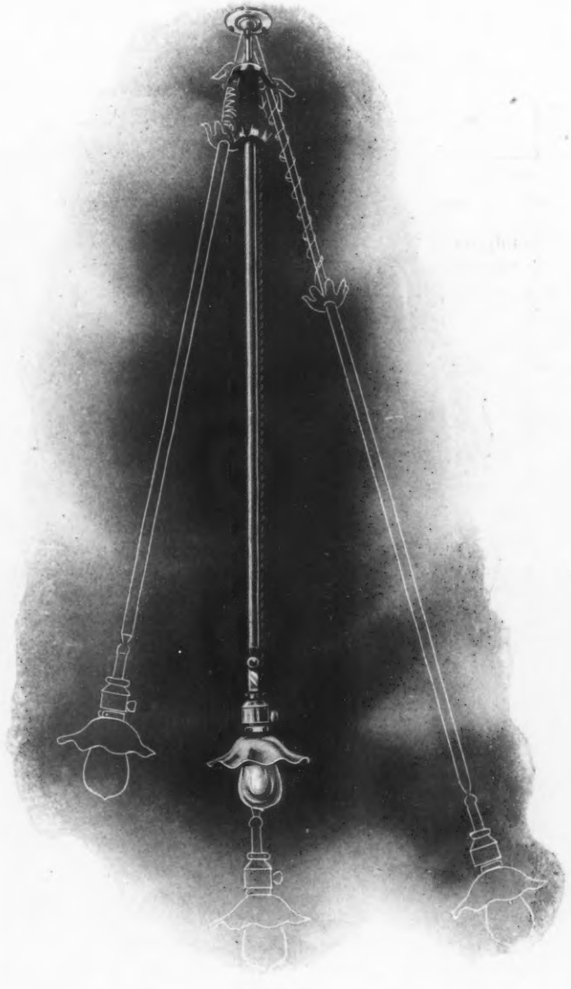


FLAT RATE CONTROLLER.

cross piece which carries switch contacts on its ends and thereby opens the circuit. The solenoid plunger terminates in an air dashpot, so that it draws up the plunger quickly, but returns slowly because of the retarding action of the dashpot. As soon as it returns, the circuit to the lamp is again closed, but as long as the current required by the lamps is in excess of the amount for which the controller is set, the controller will continue to repeat the operation of interrupting the circuit as fast as the action of the dashpot will allow. As a device of this kind operates only on rare occasions, it is not to be expected that it will wear out rapidly. It is completely enclosed in a sheet steel case. In addition to serving to limit the demand of flat rate customers, it is also applicable in connection with two-rate meter systems of charging for energy where it is desired to limit the customer's maximum demand to that for which he has contracted.

A New Adjustable Fixture.

The Greenwood Manufacturing & Supply Company, of 147 Milk Street, Boston, Mass., have put on the market a new form of universal electrical fixture, shown in the accompanying illustration. It is intended for use in offices, factories, mills, designing rooms, and other places where it is desired to throw light upon a particular area or object. This fixture consists of a ball-and-socket arrangement secured to the ceiling and a steel rod provided with a brass sliding or extension tube which can be drawn out or pushed back over the rod at will. The



ADJUSTABLE LAMP FIXTURE.

ball-and-socket permits the fixture to be adjusted to any desired position in an instant.

The lower end of the sliding tube is provided with a ball-and-socket clamp to which the lamp can be readily attached and which permits the lamp to be turned to any desired angle. On this fixture the upper part of the wire is coiled around the rod, and as the lamp is drawn down the coil is extended, the cup at the bottom of the coil pushing the wire back to a close coil as the lamp is raised. Fixtures 4 ft. and longer (when extended) are made with an extra large ball-and-socket.

Mercury-Vapor Lamps in Hat Factory.

An interesting application of Cooper Hewitt mercury vapor lamps has been made in the lighting of rooms filled with steam. The feeding mechanism of arc lamps under this condition is a source of considerable trouble resulting in continual repairs. For this class of work a special type of Cooper Hewitt lamp is supplied, with separate resistances, and the holder or fixture is made of brass except for the suspension bar and crowfoot. In order to avoid leakage of current due to condensation of steam on the inside of the suspension bar, the wires leading to the tube are carried on porcelain cleats mounted on the outside of the suspension bar. The resistances are placed

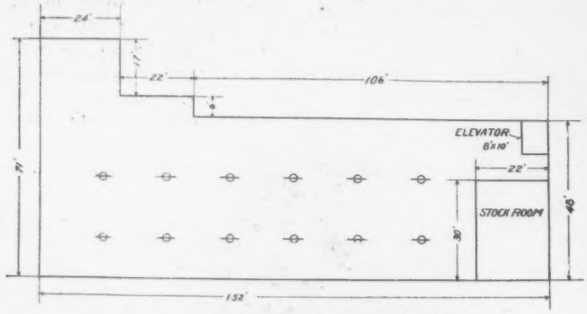


FIG. 1.—LIGHTING PLAN OF SIZING-ROOM.

preferably outside the steam room, but may, if necessary, be in the same room.

A good example of this class of work is found at the plant of the J. B. Stetson Company, Philadelphia, Pa., probably the largest hat manufacturing company in the United States. Fig. 1 gives a good idea of one of the "sizing" rooms of this company, the dimensions of which, together with the location of the lamps, are shown in the sketch; the total area of the room less elevator and stock room amounts to 7,240 sq. ft. The building is of concrete with white walls and ceiling 14 ft. high. Twelve lamps are used, two in series on 220 volts direct current, the tubes being 45 in. long and one inch in diameter. With the standard reflector the average candle-power measured from

FIG. 2.—MERCURY-VAPOR LAMPS IN HAT FACTORY.

the horizontal is as follows: At 30°, 800 cp; 45°, 955 cp; 60°, 1,100 cp; 90°, 1,200 cp.

Each lamp consumes 385 watts, or a total of 4,620 watts for the twelve lamps. This gives .64 watt per square foot of floor space lighted. Twenty-four arc lamps taking 660 watts each, a total of 15,840 watts, or 2.19 watts per square foot floor area, were formerly used to light this floor until replaced by the twelve Cooper Hewitt lamps. In this room there are 48 machines with eight men at each, or a total of 384 men. In the tipping and brim stretching room twelve tubes also replace twenty-four 3-amp., 220-volt arcs; in this room there are seven rows of machines, double, with twelve men at each row, or a total of eighty-four men. The size of these two rooms is the same.

It will thus be seen that the power consumption has been

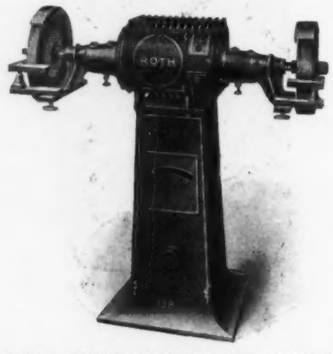
FIG. 3.—MERCURY VAPOR LAMPS IN HAT FACTORY.

reduced to 29 per cent of the amount formerly required. In other words there is a saving in power of 71 per cent. In addition to the saving in power and of much more importance is the fact that the production of the men in the room has been increased, due to the better quality and more even distribution of the light. The men are on piece work and naturally prefer an illumination which increases their wages.

The John B. Stetson Company has now 96 Cooper Hewitt lamps for this class of work, the larger portion of which have been in use for over a year without requiring any repairs, and are in first-class condition.

Motor-Driven Polisher and Grinder.

One of the distinctive features of the motor-driven polisher and grinder illustrated herewith resides in the ribs with which the motor casing is covered. The surface available for radiation of heat is increased about three times. The amount of



MOTOR-DRIVEN POLISHER AND GRINDER.

hard work and overloads which the motor will stand is largely increased, and moreover cool running is assured under normal conditions. The pedestal base contains the switch, starter and field regulator. The speed can be adjusted to suit the decreasing diameter of wheel as it wears down. In order to permit large pieces to be handled with ease, an extremely short distance is allowed between the front of the motor casing and the shaft. The equipment is manufactured by Roth Bros. & Co., Chicago, Ill.

Large Ventilating Plant in Pittsburgh.

Owing to the free public use of the Carnegie Library Extension, at Pittsburg, Pa., mechanical ventilation has been provided in all parts; and the apparatus, having been designed for conditions of maximum occupancy, is an equipment of great magnitude. In fact, it is one of the largest installations of ventilating fans ever placed in a single building, having an aggregate capacity of over 600,000 cu. ft. of fresh air per minute, and similar capacity for exhaust ventilation. To avoid excessively large units and properly sectionalize the equipment, the fresh air apparatus has been arranged in 15 sections, having 19 fans, and the exhaust equipment in 21 stations with 30 fans.

The ventilation is independent of the heating throughout the building, the fresh air supply systems being designed to deliver air tempered only to the normal temperatures of the rooms supplied. The heating is accomplished by direct radiation throughout. In only one instance is this arrangement departed from, namely, in the music hall, where it was thought desirable to provide in the fresh-air supply system, sufficient radiation to permit indirect heating if it should be convenient.

The supply fans, manufactured by the B. F. Sturtevant Co., Boston, Mass., are all of the steel plate centrifugal type, the greater part having three-quarter housings with steel bottom pans. They are driven by slow-speed multipolar motors.

Heating coils, also furnished by the B. F. Sturtevant Co., have been fitted to all but one of the supply systems for tempering the fresh air in cold weather. They have a total heating surface of 87,042 lin. ft. of 1-in. pipe. The coils are for the greater part made up of six and seven two-row sections each of the mitre type pattern. They are of 1-in. pipe screwed on 2½-in. centers into separate corrugated cast-iron headers on steam and return ends. The coils are encased in jackets of steel plate with connections to the filters and fan intakes. The tempering coils of the fresh air systems are, like the direct radiation of the heating system, under automatic thermostatic control.

Time Limit Circuit Breakers.

The Cutter Company, of Philadelphia, Pa., has developed for the market a form of circuit breaker possessing a direct-acting time-limit feature. The time-limit attachment is in reality a start delaying device; that is, the initial motion of the tripping plunger of the circuit breaker is delayed so that in case of a momentary and not too heavy or dangerous overload, this part of the circuit breaker will not immediately be brought into play but will remain inert, when, however, the overload has been maintained for a dangerous period of time, or in the event of a short circuit, the action of the plunger is practically instantaneous.

As the time-limit feature is directly connected to the tripping plunger and indeed forms a part of it, it is a direct acting device which limits the duration of the overload on the inverse-time-element principle. It is from this that the coined name "Dal-ite" is taken, meaning direct acting limit inverse time element.

By referring to the illustrations it will be seen that the point of departure from the standard I-T-E circuit breaker is found in the little cylindrical attachment placed immediately below the housing. The cylindrical vessel contains a seat for a circular disc which is suspended from the plunger co-operating with the restraining latch. The engaging faces of the disc and its seat are accurately surfaced and the disc is supported in such a manner that it may perfectly align itself with its seat. The disc when seated is surrounded with a shallow bath of specially prepared oil, serving to exclude air from between the engaging faces, which are thus separated only by a thin film of oil. It is obvious that the intimate engagement of the disc with its seat causes an additional restraint upon the plunger proportional to the total pressure of the atmosphere upon the upper surface of the disc.

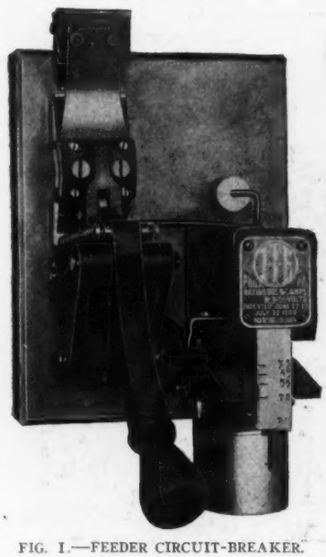


FIG. 1.—FEEDER CIRCUIT-BREAKER.

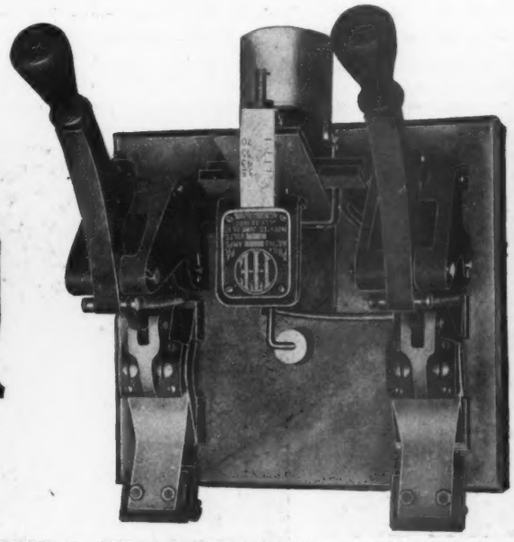


FIG. 2.—DOUBLE-POLE SWITCHBOARD CIRCUIT-BREAKER.

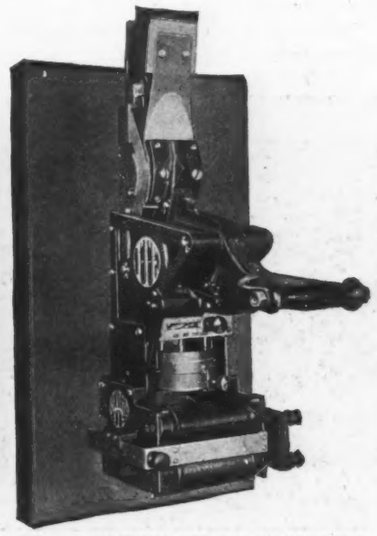


FIG. 3.—GENERATOR CIRCUIT-BREAKER.

In the event of overload, the pull of the plunger communicated to the disc, causes a gradual extension of the oil film, until, if the overload is sufficiently long continued, the film is finally ruptured, the disc is suddenly released and the plunger, which now moves forward without restraint, causes the opening of the circuit breaker in the usual manner. While the force necessary to rupture the oil film is very considerable, the movement required is almost microscopic, a fact which contributes greatly to the accurate working of the device.

To separate the disc from its seat, a certain definite amount of work must be done. The stronger the pull communicated by the armature to the disc, the more quickly this work will be accomplished and the more promptly the circuit breaker will be opened; the time element is, therefore, inversely proportional to the pull of the overload magnet which in turn is proportional to the square of the current. As a result of these conditions, the time required to cause the opening of the breaker is, broadly speaking, inversely proportional to the square of the overload current, or directly proportional to its heating effect.

It is stated that the "Dal-ite" circuit-breaker has already passed what has been aptly called the "exhibition" stage, and has demonstrated its reliability not only in the many tests to which the Cutter Company subjected it in the laboratory, but also in commercial use, where its operation could be carefully studied by engineers.

Exhibits at the Chicago Electrical Show.

In the two last issues of the Electrical World have appeared some account of the Electrical Show held at Chicago, January 14 to 26. The following are notes on some of the exhibits not previously mentioned. Additional notes will be given next week.

The Universal Manufacturing Company, 206 Illinois Street, Chicago, which has recently put a flat rate controller on the market, had an exhibit of various sizes of these controllers.

The American Sewer Pipe Company had a neat booth and gave as a souvenir to operating men and engineers a handsome bill case. This company has numerous sewer pipe factories all over the country and now is entering the conduit manufacturing field with two of its factories. Some very fine samples of duct were shown.

The Automatic Electric Company exhibited a working cross-section of a 100,000-line automatic telephone system such as it is expected to install for the Independent Telephone Company in Chicago, which is the $10,000,000 company recently formed for serving the entire city under the franchise rights of the Illinois Tunnel Company. The exhibit consists of two of the company's new Keith units of 100 switches each connected by a trunking section, and representing a portion of each of two branch exchanges.

The Haller Machine Company exhibited several interesting products of its sign works. One electric sign representing an eagle will be used as a portion of a sign for a large brewery company. When completed the sign will measure 23 by 40 ft. and will contain about 2,000 lamps. Another feature of the exhibit was a letter "K" 18 ft. high which will be used in a sign for the Oliver Plow Works at South Bend, Ind. The completed sign will measure 40 by 250 ft. Several smaller signs of the flush, grooved and raised letter types were shown.

FIG. 1.—FIRST TUNGSTEN LAMP EXHIBIT IN AMERICA.

FIG. 2.—GENERAL VIEW OF THE SHOW.

The Stromberg-Carlson Telephone Company showed as the main feature of its exhibit a large map of the United States studded with small lamps of different colors to represent points at which Stromberg-Carlson telephone apparatus is installed. There was also shown a section of a multiple switchboard for the Twin City Telephone Company at Minneapolis. This board has a capacity for 10,800 lines. The display included private exchange switchboards, central energy and generator call telephones for country use and intercommunicating systems.

The Allis-Chalmers Company, making an exhibit of small motors and generators, had a new 75-kw generator of the self-contained type; an induction motor generator set of 10 hp; direct-current motors of 1⅓ to 20 hp; and induction motors from 1 to 20 hp. The blades and stationary rings of the 500-kw steam turbine were shown. As usual in Allis-Chalmers Company's exhibits, there were plenty of pictures of their apparatus and installations of machinery. C. A. Tupper was in charge of the exhibit. A large number of representatives were present.

The Kellogg Switchboard & Supply Company showed in its exhibit a 100-line express type magneto switchboard and telephones and a central energy private branch exchange switchboard with common battery telephones. It also showed its eight-party harmonic selective system operated from a frequency pole changer and transformers, showing the latest improvements on modern party line systems. The eight-party system attracted a great deal of attention at the Kellogg booth, as it is entirely new and very successful. All working parts of the telephone and switchboard apparatus were shown, making it possible to give close examination of every piece of apparatus.

The Albert & J. M. Anderson Manufacturing Company made an exhibit of its new time switches, which are very substantial in mechanism, and can be used for cutting current both on and off without resetting for a number of operations. These switches are made in sizes from 15 to 100 amp. A new adaptable knife switch was shown which can be changed readily for use either with or without fuses, or made single or double-pole. Another very interesting feature of the exhibit was a photograph of a switch used on a low-tension, direct-current circuit of the New York Edison Company. This switch contains one ton of copper and is operated by means of hand wheels and screws. The capacity is about 15,000 amp.

Felix Hamburger, of New York, had an exhibit booth in which there was more illumination than in any other at the show. The Jupiter flaming arc lamp was exhibited, this lamp being of domestic manufacture, in designs similar to the Siemens foreign-made flaming arc lamps heretofore sold by Mr. Hamburger. The carbons, however, are imported. These arcs are of 10 and 12 amp. capacity, running two in series on 110-volt, direct-current or 60-cycle alternating circuits. Lilliput Siemens arc lamps taking 2 and 3 amp. on 110-volts with small globes limiting the air supply and small carbons were also shown. The 2-amp. lamp is stated to give 220 mean hemispherical candle-power and the 3-amp. lamp 330 mean hemispherical candle-power.

The Universal Electric Storage Battery Company, which is doing a large business in storage batteries for train lighting and automobile sparking, showed a full line of its sparking coil batteries. These are very substantially put up with special reference to the avoidance of slopping and consequent rotting of the wooden outer case. The hard rubber cell extends up some distance above the cover of the battery. It is brought up flush with the top of the wooden case. Spring clip terminals are used which are easier to manipulate and more certain in contact under vibration than binding posts. The company also exhibited a 60-cell, 100-amp.-hour battery for a small isolated plant which was shown in connection with a 1.5-kw Fairbanks-Morse gasoline engine and dynamo.

Tungsten Lamps.—The General Electric Company made the first public exhibition in this country of tungsten lamps with American-made filaments. These lamps were of 85 horizontal

cp, consuming 105 watts. The filaments consisted of five straight-sided loops in series supported on a central spider. The bulb of the lamp is the same size as the 125-watt Gem lamp, so that it will fit into the same reflectors as used on the 125-watt Gem. This exhibition of American-made tungsten lamps was naturally one in which the General Electric lamp factory engineers took much pride. Some tungsten lamps were also exhibited at the booth of the National Lamp Association. These were made in the experimental laboratory of the engineering department of the association at Cleveland. They were also of the same size bulb as the 125-watt Gem lamp.

THE SIMPLEX ELECTRIC HEATING COMPANY made a very large exhibit of its heating appliances and had demonstrators in electric cooking in attendance at the booth. The company's new range, which consists of an oven with slate table top mounted thereon and various sizes of stoves permanently fastened to the slate, is a new feature showing the advance in electric cooking details since the last show. The new range is much neater and more compact than anything in the way of an electric range heretofore attempted. A new line of coffee percolators was shown. These percolators are of a design which permits them to be tipped for pouring coffee. Instead of having a glass cylinder around the percolating chamber, the percolating chamber is of metal and is provided with a glass top which cannot come off except in one particular position. These percolators do not clamp down to the stove as do most of the other Simplex devices. Small copper kitchen water tank heaters were another new feature, as was also an electric hat iron.

CHICAGO EDISON AND COMMONWEALTH ELECTRIC COMPANIES.—On account of the great success of last year's Electrical Show, held in the Coliseum, these two central station companies enlarged the space occupied by their exhibit. Among the special features of this year's arrangements may be mentioned the illuminated beams over the entire ceiling of these spaces. These were hollow beams, two sides and the bottom were of opalescent glass. Within the space thus enclosed a large number of electric incandescents were arranged at regular intervals, so as to produce uniform illumination of the glass. Various effects were secured by means of separate circuits, controlled by centrally located switches, which make it possible to turn on either plain or colored lamps, or a combination of both within these beams. The entire exhibit was very brilliant with electric light, and a large sign, made of sectional lamp letters, and bearing the name "Chicago Edison Company" on one side and "Commonwealth Electric Company" on the other, with some additional wording below, was supported from the roof arches of the building, extending almost the entire length of the exhibit, just above the top of it. Considerable space in the exhibit was devoted to the uses of the reception room There were some souvenirs distributed here, among which might be mentioned a useful little book of electric chafing dish recipes and a pretty little calendar. There were various demonstrations of cooking by electrical utensils in one section of the exhibit. The electric heating devices included the well known "Electrotherm," or electric heating pad, luminous electric air heaters of two sizes, and various small car-type electric radiators and carriage foot warmers. Among electrically heated utensils will be found the popular flat-iron, curling iron heaters, and soldering irons. A large space was devoted to the publication of the *Electric City Daily*, a sixteen-page paper, printed, folded, stitched and trimmed by machines of the latest type, all operated by individual electric motors. Lady visitors were particularly interested in the application of electric power to the operation of sewing machines, washing machines, wringers and other household devices. Electric energy for ventilating purposes, the convenience and adaptability for which have put it in first place, was exemplified by a system of ventilation applied to this entire exhibit, exhaust fans removing the super-heated atmosphere near the ceiling, and blowing it up toward the roof of the building, while the fresh air comes through vents in the floor to take its place. A novelty which interested all visitors was the operation of a stereopticon, using two twenty-ampere electric arcs, and throwing a varied assortment of views upon a screen some three by four feet in size, and consisting of a large ground glass plate set in a frame only a short distance from the stereopticon. The views seen through this glass plate represented various scenes in and about the modern electric generating stations of the two companies, as well as interesting pictures of street and interior electric illuminations, and important applications of electric power for manufacturing purposes. One space in the exhibit was devoted to the exhibition of various electrical construction supplies sold by the supply department of the two companies, including large and small cables, insulating material, various kinds of single and multiconductor insulated wire, and numerous specialties. Mr. D. H. Howard, of the Advertising Department, was in charge of the exhibit, and Mr. Herbert A. Seymour edited the *Daily Electric City*, published in the exhibit and containing articles of interests to the electrical fraternity.

THE WESTINGHOUSE EXHIBIT was one of the largest and was notable for the great number of motor applications shown, most of them in actual operation. A dough mixer of J. H. Day & Co.'s manufacture was driven by a 2-hp Westinghouse motor. A centrifugal pump manufactured by the Dayton Hydraulic Company was operated by a 1-hp motor. An ironing mangle of the American Ironing Company's make was operated by means of a ⅛-hp alternating-current motor. This is suitable for a domestic laundry. A Singer sewing machine driven by a 1/25-hp alternating-current motor, was on exhibit. A Conkling laundry washer, of a size particularly adapted to laundries and hotels, was operated by a 3½-hp motor, and alongside it was displayed a family size washer, made by the 1900 Washer Company, the latter being operated by a small motor. The device applied to the large Conkling washer for the reversal of the cylindrical tub, obviates the necessity of reversing the motor. A generating set consisting of an engine made by the American Blower Company and a Westinghouse 7-kw generator was shown, and also an American Blower 24-in. fan was operated by a Westinghouse ½-hp motor. A 1/20-hp DZ direct-current motor was used to operate an automatic pin ticketing machine. A Gould's triplex pump was electrically operated. The Larsen-Baker Ice Machine Company, demonstrated the adaptability of electric motors for ice making and refrigeration while near by a ten-gallon ice cream freezer, made by Thos. Mills & Co., was motor-driven. A forge made by the Champion Blower & Forge Company, a 16-in. engine lathe made by the American Tool Works Company; a Hoeffer drill press; a Chandler & Price printing press, a Henry Tromner coffee grinder, a Blakeslee dish washer and a small house tank pumping outfit made by Erwin & Co., were separately operated by motors adapted to the varying classes of service. Saws were sharpened at the exhibit on the saw sharpener made by the Covel Manufacturing Company, and driven by a ½-hp motor. Undoubtedly the demonstrations made by the Sanitary Dust Removing Company created more interest than any other demonstrations at the exposition. The entire exhibit of the Westinghouse Companies, as well as some of the adjoining exhibits, was cleaned from time to time by means of this vacuum process, which was driven by a 3-hp motor. Two electrically-operated Columbia graphophones demonstrated the commercial use of graphophones for correspondence. A stenographer was in attendance, who transcribed from the graphophone records such letters as were dictated by visitors at the exhibit. A fairly complete line of apparatus designated by the Westinghouse Electric & Manufacturing Company, as "Details and Supplies," was exhibited, the various types of electric instruments being attractively mounted upon marble switchboards. These details consisted in part of the following: Watt-hour meters of the single, polyphase and prepayment alternating-current types; a line of portable instruments, samples of various types of fan motors; samples of low-voltage line material; also of catenary line material for high-voltage, single-phase railway installations; various types of lightning arresters, oil switches and circuit-breakers; samples of all types of lighting and power transformers under 50 kw and a full line of small power motors for alternating and direct-current circuits. The lighting of the

exhibit was adequately provided for by six different types of illuminants, these being alternating-current multiple and alternating series arc lamps. In conjunction with the latter six Nernst lamps of the street series type were kept burning, the current being regulated by a Westinghouse current regulating transformer. Cooper Hewitt mercury vapor lamps, both types H and K, were lighted to demonstrate their advantages for shop lighting. Sawyer-Man incandescent lamps were shown in a neatly arranged sample case.

Annual Show of the Association of Licensed Automobile Manufacturers.

The annual show of the Association of Licensed Automobile Manufacturers was held in Madison Square Garden, New York, January 12 to 19. This show, as well as that of the Automobile Club of America, noted in our columns a few weeks ago, has assumed such proportions that it is difficult to house it in the largest building in the metropolis. The popularity of these shows is also such that notwithstanding the doubling of the admission price during the show just closed, no noticeable diminution in attendance resulted. With reference to the exhibits much might be said did space permit. As a whole the show did not vary much from that of the Automobile Club of America, and the exhibits of accessories were in most cases alike, so that what might be said regarding the latter would be merely a repetition of what was published in our issue for December 29. In one instance in particular did the show differ radically from its immediate predecessor, and that was in the number of electrical vehicles exhibited. The purely pleasure vehicles were allotted space in the restaurant of the foyer. There were seven makes on exhibition including all told about forty individual cars, ranging from runabouts to limousines, landaulets, opera 'buses and roadsters.

As for the cars themselves, it was evident that in all that pertains to the comfort of the occupants, as well as the manner in which both the fitting and finish were executed, the electric vehicle surpassed any other type of automobile on exhibition. Couple with this the ease, simplicity and noiselessness of operation and the growing popularity of the electric vehicle especially for city use is accounted for. These are virtues which no other type of vehicle possesses and after the craze for high-speed cars has spent itself and the cost of up-keep becomes manifest, these virtues of the electric machine are appreciated as never before. Compound-wound and series-wound motors capable of standing excessive overloads for long periods are still characteristic of the power equipment with a tendency toward the single motor shaft-driven type of car. Most of the cars, however, are chain driven.

The Babcock Electric Carriage Company showed a line of luxurious electric vehicles. A stanhope, victoria and roadster of special design formed a prominent feature of the exhibit. The roadster was equipped with two ½-hp specially-wound motors and 24 cells of battery and has a radius of action of 100 miles. The stanhope is equipped with 40 cells; but none of the cars complete weighs a ton, the roadster weighing 1,500 lbs. and the victoria 50 pounds more. The fittings are all elaborate and losses are reduced to a minimum so as to increase the ratio of power to weight and thus the radius of action on a single charge.

A feature of the Baker Motor Vehicle Company's exhibit was an electric roadster built on the lines of a modern high-powered gasoline runabout. Under the hood is a battery of 32 Exide cells capable of driving the car 60 miles at the rate of 14 miles per hour. The highest speed attainable is 30 miles per hour, the radius of action being correspondingly lessened. The vehicle is equipped with a single 3½-hp series-wound motor capable of a 300 per cent overload, and has six speeds forward and three speeds reverse, the operating lever being on the steering wheel. In addition to this roadster, the Baker interests also displayed a standard runabout, a brougham, a stanhope and a victoria. The batteries in the smaller and lighter vehicles are made up of 24 cells, while those in the larger vehicles consist of 40 cells.

The Cantono Electric Tractor Company showed a fore-brougham with extension straight front and a fore-landaulet. In these, the motive power is concentrated on the forward truck contrary to the usual practice. Motors, batteries, controllers and all connections are self-contained on the front part of the car, the wheels of which are made extra heavy to carry the weight. The fore carriages are equipped with 5-hp motors and a battery of 44 cells.

Among the cars shown by the Columbus Buggy Company were a stanhope and a coupé together with two surreys. Twenty-four cells of battery are used in each vehicle and the effective radius is between 40 and 75 miles in the lighter vehicles and between 50 and 60 miles for the surreys.

The Electric Vehicle Company showed its line of cars which have long been looked on as standard. In the heavier types there were the victoria, brougham and landaulet besides a private hansom. The vehicles carry a battery of 44 Exide cells, and in every respect of detail and refinement are monuments of the carriage builder's art. A light victoria-phaeton equipped with a battery of 24 cells was a feature of the exhibit. Chief among this company's models was a gasoline-electric automobile. The engine is of the standard four-cylinder vertical type, the field frame of the generator being in direct connection with the crank shaft of the engine, taking the place of the fly-wheel. The shaft holding the armature of this revolving-field generator extends through to the driving bevel in the rear axle housing which contains the bevel gear drive and the differential, these being the only gears in the machine. In line with the generator and directly behind it, is a motor whose armature is mounted upon the same driving shaft which extends from the generator to the driving pinion. The generator serves as a clutch transmitting the driving effort of the engine directly to the driving pinion. Changes of speed are obtained through a controller giving five forward and two reverse speed connections. There is no mechanical connection between the generator and the motor except at high speed when the crank shaft of the motor and the propeller shaft terminating at the rear axle become solidly coupled and both the dynamo and motor run dead. The low speeds are used in starting, the motor being capable of withstanding heavy overloads, and when the machine is brought up to speed a clutch is employed to couple the motor and the propeller shafts, the car running exactly as one equipped with the usual change-speed gear.

The Pope Manufacturing Company showed a very wide range of types of Pope-Waverly electric vehicles. A stanhope of special design formed the center of attraction. This, as well as the other stanhope, and a victoria-phaeton was equipped with a battery of 30 cells. In the latter vehicle 10 cells are placed forward and the remainder in the rear compartment so as to distribute the weight. The station wagon exhibited was equipped with 41 cells of battery. Both of the stanhopes and the victoria-phaeton are equipped with a single motor driving the rear wheels through the medium of a special "herring-bone" type of gear which is a feature of this make of vehicle.

The Studebaker Automobile Company's exhibit in so far as the number of styles shown was concerned formed one of the most complete of its kind in the Garden. Six distinctive types were shown ranging from the runabout to a heavy surrey.

Among the commercial vehicles exhibited in the basement were a variety of types, both of gasoline and electric drive. Eleven electric vehicles were on exhibition and no changes from what is considered to be established practice were evident. The Pope Motor Car Company with two vehicles, the Studebaker Automobile Company with four vehicles and the General Vehicle Company, comprised the list of electric vehicle exhibitors. The constructional methods of electric vehicles are so well understood that further comment is unnecessary. The electric vehicle is admittedly supreme in the commercial types.

Industrial and Commercial News

Commercial Intelligence.

THE WEEK IN TRADE.—The variable weather of the past week made itself felt in retail and wholesale trade, industry and transporation alike. The entire Northwest has had snowstorms followed by intensely cold weather, the central West and Southwest heavy rains, and the South has been unseasonably warm. The reports from the winter wheat crop are not conclusive. Very heavy rains followed by sleet and ice are reported in parts of the winter wheat belt. There was renewed confidence in the iron and steel trades. The demand for structural material also showed improvement, particularly in the West, where specifications are coming in more freely. Railway interests are the most liberal purchasers, demand being improved for bridge work and car building. Improvement in the traffic situation was checked by snow blockades. In the Northwest coal trains have the right of way and the grain movement has been light. Railway earnings thus far reported for January were 15.6 per cent larger than for the same period last year. Copper prices continue to move upward, the quotation on Lake ranging between 24¾ and 25¼ cents per pound, and even higher prices prevailing where prompt shipment is demanded. The business failures for the week ending January 17, as reported by *Bradstreet's*, numbered 234 against 283 in the week previous and 279 in the corresponding week of last year.

THE NEW YORK & LONG ISLAND RAILWAY COMPANY, known as the Belmont or old Steinway tunnel system, has just awarded a contract to the Otis Elevator Company for the two largest escalators ever built, to be installed in the Manhattan terminal of that system at Forty-second Street, between Lexington and Third Avenues. Trolley cars instead of trains are to be operated in this tunnel and these running on short headway provide a tremendous capacity. It is estimated that the capacity will be at least equal to that of the trains of the present Brooklyn Bridge during rush hours, and the escalator equipment above referred to is equal in point of capacity to that of the entire stairway equipment of the Manhattan end of the Brooklyn Bridge. Furthermore, not only will the escalators be sufficient to handle any number of people up to the capacity of the trolley cars of the tunnel, but they will also serve to marshal the crowds into streams of people moving uninterruptedly and not coming into conflict with one another. The escalators will provide service between levels something over 55 feet apart and will be arranged side by side. Most of the time one will be operated ascending and the other descending, but during the morning rush hour both will be operated ascending. As an appropriation has already been made for a new Manhattan terminal to the Brooklyn Bridge, which is to be located underground, it will be interesting to note whether this municipally owned enterprise will be as progressive as the privately owned one in the matter of installing moving stairways. The escalators in common with the entire terminal possess no wood work or other inflammable material. As is well known, the escalator is the invention of Mr. Charles D. Seeberger, who is now head of that department of the Otis Elevator Company.

RECENT CROCKER-WHEELER SALES.—The Crocker-Wheeler Company, of Ampere, N. J., reports among its recent sales the following motors and generators secured the latter part of last year for delivery in 1907. One of these firms has purchased thousands of horse-power during 1906, including a number of rolling mill motors which have been so successful though on the market only a short time. This motor is, it is said, the first and only rolling mill motor which has been designed for the heavy duty to which such motors are subjected: National Tube Company, McKeesport, Pa., one 75-hp., 230-volt, direct-current motor; Union Rolling Mills, Cleveland, O., one 100-kw, 250-volt, 250 r.p.m., direct-current generator; Peoria Stone & Marble Company, Peoria, Ill., one 200-kw, 250-volt, 115 r.p.m., direct-current generator; Ford Morocco Company, Wilmington, Del., one 100-hp, direct-current motor, 500 volts; Union Gas & Electric Company, Cincinnati, O., three 35-hp, 240-volt, direct-current motor for driving ventilating fan; Bethlehem Steel Company, one 500-kw, direct-current motor, 240 volts, 450 r.p.m.; Schlather Brewing Company, Cleveland, O., two 25-hp, 220-volt, direct-current motors, 550 r.p.m., for driving washing machines; Ellsworth Coal Company, Ellsworth, Pa., one 50-hp and one 15-hp, 230-volt, direct-current motor; Stone Printing Company, Roanoke, Va., 49 motors ranging from ¼ to 100 hp.

EXPORTS OF THE YEAR.—According to the data from the Bureau of Statistics of the Department of Commerce and Labor, the export figures of the year indicate great activity on the part of the manufacturers, since in the large proportion of cases they show an increase in quantity as well as value of manufactures exported. The total value of manufactures exported in the eleven months of 1906 was, of manufactures for further use in manufacturing, $220,000,000 against $194,000,000 in the corresponding months of the preceding year, and of manufactures ready for consumption $438,000,000 against $391,000,000 in the corresponding period of 1905, thus indicating that the total value of manufactures of all kinds exported during the year will exceed $700,000,000 against less than $650,000,000 in the preceding year. Iron and steel manufactures exported in the eleven months of 1906, for which statistics are now available, show an increase of $28,000,000 over those for the corresponding months of the preceding year; lumber, an increase of $9,000,000; refined mineral oil, an increase of $5,000,000; cars and carriages, an increase of nearly $5,000,000; pig copper, an increase of $4,000,000; instruments and apparatus for scientific purposes, an increase of nearly $4,000,000; agricultural implements, an increase of about $2,000,000, and naval stores also an increase of about $2,000,000.

MEXICAN MINING EQUIPMENT.—The Campania Minera Borda Antigua y Anexas, S. A., whose mines are located close to the Dos Estrellas mines, near Tlalpujahua, have recently placed an order with Messrs. G. & O. Braniff & Company for an electrical installation for their mines. The motors, transformers, etc., will come from the works of the Westinghouse Electric & Manufacturing Company, Pittsburg, Pa., and the pumps from the Byron Jackson Machine Works, of Oakland, Cal. There is already on the ground, being erected, a 250-hp Lidgerwood Manufacturing Company steam hoist, purchased before electric power entered the camp. The Westinghouse people will attach to this hoist one of their standard 150-hp alternating-current hoist motors, the only necessary change in the hoist being the adding of gear and pinion to adapt the drive. In the way of pumping outfits there will be provided four horizontal centrifugal pumps, direct-coupled to alternating-current motors. Also two motors for driving blower for ventilating the mines, three 50-kw transformers will be used to change the voltage of the Mexican Light & Power Company's circuits from 3,000 volts to 400 volts for motor and lighting work.

THE PELTON WATER WHEEL COMPANY, San Francisco, reports unusual activity and carries over from 1906 unfilled orders aggregating the largest in the history of its business. The marked tendency is towards high-speed large power units. For example, the California Gas & Electric Company is installing a wheel of 10,500 hp maximum capacity. The Telluride Power Company, of Colorado, is adding to its equipment one 5,000-hp wheel operating under a head of 900 ft. and one 4,000-hp Pelton wheel under 1,800 ft. head. This company has installed a continuous lap-weld, high-pressure pipe made by the Ferrum Company, of Germany, which the Pelton Company has introduced in this country with much success in the past two years. The Siskiyou Electric Power Company has ordered two wheel units, each of 2,000 hp capacity, these being in addition to its present water wheel equipment.

TELEPHONE COPPER.—The statement is made from Boston that the American Telephone & Telegraph Company used in 1906 about 55,000,000 pounds of copper, the value of which at 20 cents would be $11,000,000. It is not stated how the total is reached.

DUBOIS IRON WORKS.—The DuBois Iron Works, DuBois, Pa., a $1,000,000 corporation, have taken over the entire business of the Lazier Engine Mfg. Co., Buffalo, N. Y. The DuBois Iron Works have been manufacturing gas and gasoline engines for years under the patents and designs of Mr. Arthur A. Lazier, former vice-president and general manager of the Lazier Engine Mfg. Co., who has sold out his entire interests and retires from the business management and company. While in general appearance the future engine manufactured may look the same, numerous improvements and changes will be made, which will put "DuBois" (the name they will be sold under) far in advance of any of the horizontal gas or gasoline engines now claiming the distinction of being the best known to modern gas engine practice. The DuBois Iron Works have not only improved the engine in construction and design but have made it possible to operate on natural, illuminating, coke oven gas, gasoline, alcohol, distillate, crude oil and kerosene in sizes ranging from 5 hp to 300 hp. Mr. Peter Eyermann is chief of the engineering department and under his designs and supervision, the new and improved engines will be produced. The DuBois Iron Works will continue the manufacture of their simplex steam pump. The officers of the company are Mr. John E. DuBois, president; Mr. W. C. Pentz, vice-president; Mr. E. A. Badger, secretary and treasurer, with Mr. I. N. Hamilton as general manager. The sales and advertising department will be in the hands of Mr. C. E. Stuart. The head office and entire management will be located at DuBois, Pa., and at Buffalo a branch office will be retained, together with branches in the principal cities of the country.

PACIFIC GAS & ELECTRIC.—It is again currently reported that the properties owned by the Pacific Gas & Electric Company are to be purchased by the Western Power Company of New York. A local paper states: "A syndicate of capitalists, headed by President Edwin Hawley, of the Western Power Company and interested in that corporation, are negotiating for the purchase of a huge block of the common stock of the Pacific Gas & Electric, held by N. W. Halsey & Company, the New York and San Francisco bankers. This means that $20,000,000 out of the total issue of $24,000,000 of common stock will change hands and with it the control of the local gas combine. Halsey & Company one year ago put through the deal whereby the San Francisco Gas & Electric Company and the California Gas & Electric Corporation were merged in a new corporation, called the Pacific Gas & Electric. The stockholders of the San Francisco concern agreed to accept for each $100 share $90, of which $25 was payable in cash and $65 in bonds in the new combine. Halsey & Company furnished the $25 cash and the Union Trust Company was made the depositary. Halsey & Company received as their share in the transaction $20,000,000 of the common stock. The remaining $4,000,000 of common stock and $6,000,000 of preferred went to John Martin and Eugene de Sabla, owners of the California Gas & Electric Corporation, and other promoters who negotiated the merger. It is understood that Halsey & Company are willing to part with their $20,000,000 of common stock and that Edwin Hawley and his associates are willing to purchase."

A MODERN PLATE GLASS PLANT.—The Crystal City Plant of the Pittsburg Plate Glass Company is now about completed at Crystal City, Mo., 28 miles below St. Louis. There are 15 buildings, all of reinforced concrete. It is estimated that 50,000 bbls. of cement will be used in the building process, the brand being the "Universal Portland" made in the cement division of the U. S. Steel Corporation. In the equipment of this huge plant, due provision has been made for adopting the most modern methods of manufacture. Among industrial plants of its kind, this establishment is unique as being one of the largest in the country, and also as being remarkable because of the unusual size of the power and lighting units installed there. The machinery will be driven by electric motors of exceptional capacity. The power equipment already contracted for includes an 1,800 B.H.P. Allis-Chalmers gas engine direct connected to a 1,000-kw Allis-Chalmers generator. This unit will be installed in the same power house with a 5,000-hp Allis-Chalmers engine, famous as the "Big Reliable." This engine carried the entire lighting load for the illuminating of buildings and grounds of the Louisiana Purchase Exposition at St. Louis. The name was given it by the attendants because of continued good service during the entire duration of the Fair. Sixteen hundred horse-power in Allis-Chalmers induction motors will be used to drive grinders and polishers.

ICE AND ELECTRICITY.—A new artificial ice company is being formed in Philadelphia, to be known as the Central Crystal Plate Ice Company, with five plants in different sections of the city. The officers will be: President, H. O. Bernhardt; vice-president, Mr. Hunt; engineer in charge of construction and equipment, William Cook, all of Philadelphia. Mr. Bernhardt was formerly manager of the Standard Ice Co., and Mr. Hunt was at one time vice-president of the Knickerbocker Ice Co. The concern is designed to be co-operative, and will sell only wholesale to the independent dealers, and not to consumers direct. It is understood that no stock will be offered to the public. There will be three plants, of 100 tons capacity, capitalized at $40,000. A contract has been let to the Allis-Chalmers Company to install in each a 100-kilowatt generating plant for light and power. There is a big field for artificial ice development in this shape, or in connection with lighting and power companies.

APPARATUS FOR MEXICO.—United States Vice-Consul C. M. Leonard reports that the company owning the street railway system of Chihuahua, Mexico, which is now being operated by horse power, will shortly change to electricity, using the overhead trolley system. Bids are being asked for cars, rails, overhead fixtures and machinery for the power plant. A liberal concession has been granted the company by the State government, and under this concession the company proposes to build about 20 miles of line, about half of which will be constructed as soon as material can be obtained and the balance as traffic demands it. The gauge of the track will be 4 ft. 8½ in., and 80-pound T-rails will be used. Chihuahua is a growing city of 30,000 inhabitants, and it is expected that with the introduction of an electric street car service a great impetus will be given to suburban building and real estate operations. Mr. A. C. Nash is the present general manager of the street railway company.

BELL TELEPHONE OUTPUT.—The American Telephone & Telegraph Company instrument statement for the month ended December 31, 1906, compares as follows:

	1906.	1905.	1904.	1903.
Gross output	163,260	163,828	122,285	88,947
Returned	71,483	57,381	49,898	39,678
Net output	91,777	106,447	72,387	49,269
Twelve months:				
Gross output	2,168,871	1,841,628	1,216,576	1,109,888
Returned	759,293	623,934	715,529	480,691
Net output	1,409,578	1,217,694	701,047	629,197
Total outst.....	7,107,836	5,698,258	4,480,564	3,779,517

PIQUA BLOWER COMPANY.—The Piqua Blower Company, of Piqua, Ohio, is being incorporated under the laws of Ohio with a capital of $50,000 to take over the interests of the Piqua Foundry & Machine Company. It will make a specialty of the manufacture of positive blowers and gas exhausters as developed by the latter company in the past two years. As the machinery of the latter firm has met with great success it is necessary to effect this reorganization in order to take care of the large volume of business offered.

ORDERS FOR GENERATING SETS.—The B. F. Sturtevant Co., of Boston, Mass., reports recent sales of generating sets with enclosed forced lubrication engines as follows: Hudson Companies, Jersey City, N. J.; American Milling Company, Linden, Ind.; Maryland Steel Company, Sparrow's Point, Md.; The Cox & Sons' Company, Swedesboro, N. J.; C. N. O. & T. P. Ry. Co., Lexington, Ky.; Bristol Water Works, Bristol, Pa., and for two of the Panama dredges.

TITANIUM.—The Titanium Manufacturing Company has bought a lot of four acres at Lewiston, N. Y., on the Niagara River, near the Falls, where it will build a plant for the manufacture of titanium and titanium alloy, to be used in steel manufacture, as well as for the manufacture of special alloy steel products. The electrical energy from the Falls will be utilized in the production of the material and for driving the plant.

ALLIS-CHALMERS AFFAIRS.—It is stated that the new business of the Allis-Chalmers Company received in the month of December aggregated $1,700,000. The company now has upon its books an amount of about $13,000,000 of unfilled business.

STURTEVANT VENTILATING FANS are being installed in Broadway Savings Institution, New York City, and Commercial National Bank, Chicago, Ill.

POWER FROM SAVANNAH RIVER.—It is stated that over 100,000 hp will be developed on the Savannah River by a company now being organized by Messrs. Hugh MacRae & Co., of Wilmington, N. C., and Washington, D. C. This new company will probably be known as the Savannah River Power Company, and will be a consolidation of the present Savannah River Power Company, the Calhoun Falls Company and the Hatton's Shoals Company, the latter having just been purchased by Messrs. MacRae & Co. The capitalization of the undertaking will be approximately $8,250,000, divided as follows: Bond issue $3,500,000, preferred stock $1,750,000 and common stock $3,000,000. This construction work proposed will involve an outlay of $4,300,000, and will include the building of dams and power houses, machinery and equipment and transmission lines, as follows: Gregg's Shoals, $350,000; Cherokee Falls, $550,000; Calhoun Falls, $2,500,000, and Hatton's Shoals, $900,000. These four powers will be developed at present for about 59,000 hp, including 35,000 hp at Calhoun Falls, 4,000 at Gregg's Shoals, 10,000 at Cherokee Falls and 10,000 at Hatton's Shoals. Electrical energy will be supplied to the cotton mills and other industries in Western South Carolina and a portion of Georgia, the transmission lines in complete circuit covering about 200 miles. Plans have been worked out by J. E. Sirrine, of Greenville, S. C., the company's engineer. The dam, 13½ ft. high, and power house at Gregg's Shoals are nearly completed, all machinery and equipment have been purchased, transmission lines are under construction, and power will be delivered this spring. Work on the Cherokee Falls dam, 25 ft. high, and power house will be started shortly. Preliminary surveys and plans for the power house and 75-ft. dam at Calhoun Falls have been made by Messrs. Viele, Cooper & Blackwell, 40 Wall street, New York.

ATLANTIC CITY TRAIN EQUIPMENTS.—Because of the increased traffic on the Camden-Atlantic City electric trunkline, it has become necessary to add to the present rolling stock some twenty-one cars. Both the new cars and the generating apparatus necessary to care for the extra load are similar to the present equipment. Each of the cars will be driven by a 200-hp double-motor equipment and will be fitted with the Sprague-General Electric Type M control. At the Westville power house a fourth 2,000 kilowatt, 6,600 volt, 25 cycle, three-phase, Curtis steam turbo-generator will be installed. Additional boiler capacity, with the necessary condenser and feed pumps, switchboards, etc., will also form a part of the new equipment, as well as a 75 kilowatt, 125 volt, horizontal Curtis steam turbo-generator for excitation purposes. Three extra 700 kilowatt, air-blast transformers will step up the generator voltage to 33,000 volts for transmission. Six 1,000 kilowatt rotary converters will be distributed in the sub-stations; one each at South Camden, Glassboro, Newfield, Mizpah, Atlantic City, and one at the Westville power house. The accompanying air-blast transformers for these machines have a capacity of 370 kilowatts each, three being installed with each of these rotaries. The Pennsylvania Railroad has ordered all the additional apparatus for this system, as outlined, from the General Electric Company, which also furnished and installed the initial equipment. This line was described and illustrated in a recent issue of this journal.

CHASE-SHAWMUT SWITCHBOARDS.—On account of the great increase in demand for the staple specialties manufactured by the Chase-Shawmut Co., of Newburyport, Mass., and the consequent need of more room and machinery in its factory, it has sold out its entire patent Theatre Switchboard interests to James S. Pennefather, New York. With more space and machinery the Chase-Shawmut Company is better equipped than ever for giving prompt attention to orders.

SALES OF STURTEVANT ENGINES.—Among recent purchasers of the B. F. Sturtevant Company's vertical enclosed forced lubrication engines are Hudson Companies, Jersey City, N. J.; Hartmann Brewing Company, Bridgeport, Conn., and Nashua River Paper Company, East Pepperill, Mass.

NEW EQUIPMENT.—The New York, New Haven & Hartford Railroad is to spend $12,000,000 of its short term notes in extensions and improvements, and other payments for trolley systems in the States of Rhode Island, Massachusetts and Connecticut.

Financial Intelligence.

THE WEEK IN WALL STREET.—The stock market was dull and inclined to be weak on the announcement of new stock issues or the prospect of additional issues of securities by various other railways. A certain amount of support was given to the Harriman group, but Amalgamated Copper was depressed by the failure to increase the dividend rate. The improvement in the money market failed to have any stimulating effect on speculation in view of a number of developments, some of them unfavorable in their nature, and others so construed by the Street. The United States Steel stocks, on a moderate amount of business, were somewhat firmer than the majority of the list. With the exception of General Electric and Westinghouse, all of the electric stocks are lower. The heaviest loss was in Allis-Chalmers preferred, which declined 5¼ points, closing at 38¼; the common dropped 1½ points at the close of the week. General Electric advanced 1⅛ points on the week's business, and Westinghouse 2 points. Brooklyn Rapid Transit is down 3⅜ points on rather small trading. The market for outside securities was conspicuous for its great irregularity, with decided weakness during the latter part of the week in sympathy with the collapse in the main exchange. The various issues, such as Chicago Subway, broke several points in a single day. There was some bidding up of mining stocks early in the week, but this was intended to get a better basis to sell on. The week ended with most issues substantially lower than they were at the end of the previous week. Following are the closing quotations of January 22:

NEW YORK

	Jan. 15	Jan 22		Jan. 15	Jan. 22
Allis-Chalmers Co.	15¼	15⅝	General Electric	155⅛	161¼
Allis-Chalmers Co. pfd.	39¼	40	Hudson River Tel.	...	...
American Dist. Tel.	...	...	Interborough Met. Com.	36¼	36⅛
American Locomotive	73⅛	73	Interborough Met. pfd.	73⅛	72¼
American Locomotive pfd.	109⅛	111	Mackay Cos.	73⅛	73
American Tel. & Cable	85	83	Mackay Cos. pfd.	70¼	70¼
American Tel & Tel.	...	...	Marconi Tel.	...	...
Brooklyn Rapid Transit	81	76⅜	Metropolitan St Ry.	...	...
Electric Boat	...	30	N. Y. & N. J. Tel.	...	...
Electric Boat pfd.	...	73	Western Union Tel.	83⅛	83⅛
Electric Vehicle	30	...	Westinghouse com.	148¼	151⅝
Electric Vehicle pfd	73	...	Westinghouse pfd.	...	...

BOSTON

	Jan 15	Jan. 22		Jan. 15	Jan. 22
American Tel & Tel.	130	128	Mass. Elec. Ry. pfd	70	68
Cumberland Telephone	...	1⅛	Mexican Telephone	...	4
Edison Elec. Illum.	224	...	New England Telephone	...	122
General Electric	158	161½	Western Tel. & Tel.	...	8¼
Mass. Elec. Ry.	19½	...	Western Tel. & Tel. pfd.	80	79¼

PHILADELPHIA

	Jan. 15	Jan. 22		Jan. 15	Jan. 22
American Railways	50⅛	50⅛	Phila. Electric	8	7¾
Elec. Co. of America	11	10⅝	Phila. Rapid Trans	19¼	22¼
Elec. Storage Battery	67	65	Phila. Traction	94	96
Elec. Storage Battery pfd.	...	...			

CHICAGO

	Jan. 15	Jan. 22		Jan. 15	Jan. 22
Chicago City Ry.	160	160	National Carbon	80	80
Chicago Edison	...	...	National Carbon pfd.	117	117
Chicago Subway	41⅛	40	Union Traction	...	...
Chicago Tel. Co.	...	...	Union Traction pfd.	...	...
Metropolitan Elev com.	22	27			

*Ex-dividend

POTOMAC ELECTRIC BONDS.—Brown Bros. & Co., of New York, offer $1,300,000 of the 5 per cent consolidated mortgage gold bonds of the Potomac Electric Power Company of Washington, the principal and interest guaranteed by the Washington Railway and Electric Company. The bonds are due July 1, 1936, and interest is payable January 1 and July 1. These bonds are exempt from taxation under any present or future laws of the United States or the District of Columbia, and are amply secured by a first mortgage. The total amount authorized is $7,000,000, of which $2,350,000 are reserved to retire the underlying bonds mentioned. The remainder may be issued for the actual cost of extensions and improvements.

ENGLISH CALLS FOR CAPITAL.—The application for capital in England during 1906 for the promotion of various new enterprises amounted to £120,173,200, compared with £167,187,400 in 1905, and £123,019,000 in 1904. Among the chief ventures financed were the Victoria Falls electrical power plant £625,000, motor traction and manufacturing £4,143,500, electric lighting, power, etc. £5,316,400.

CHICAGO INDEPENDENT TELEPHONE.—The independent telephone interests that have bought the telephone department of the Illinois Tunnel Company have paid the first 10 per cent installment of $1,000,000. The actual work of development began on January 1.

TELEPHONY IN KENTUCKY.—An offer has been made to the stockholders of the Louisville Home Telephone Company by the Kentucky Telephone Securities Company to take over the control of the local telephone plant and guarantee the payment of a 5 per cent dividend in 2½ per cent semi-annual installments, the first payment to be made July 1, 1907. A cash guarantee of $50,000 is to be deposited in a trust company of standing to insure the payment of each of the dividends, and if the holding company should default in the payment of the dividend for thirty days succeeding any dividend period the guarantee is to be used in paying the dividend, and those stockholders in the Home who enter the agreement will be privileged to surrender the trustee certificates given in exchange for their stock and have their stock returned to them, thus again securing control of the company. The proposition also pledges the security company to devote itself exclusively to the interests and betterment of the Louisville Home Telephone Company. As the voting privilege of Home Telephone shares are vested in a voting committee, the taking over of the control of the company is made possible by reason of the fact that at a recent meeting of the voting committee a resolution was adopted agreeing to elect as directors such persons as may be the choice of a majority of the Home stockholders at the annual meeting early in February. The company has been paying dividends for about two years, starting at the rate of 3 per cent a year. For the past year it has been paying 4 per cent.

NEW YORK CONSOLIDATED GAS.—At the annual meeting of the Consolidated Gas Company, of New York, this week, a report was read reviewing the investigation and court proceedings that had been brought against the company during the past two years and giving the present status. It was stated that under the order of the court compelling the company to deposit the difference between the $1 rate for gas and the 80-cent rate up to December 31, 1906, there had been deposited with the court $1,994,417. It was stated that the city had paid nothing to the company for gas since December, 1902. Up to December 31, 1906, there was due the company from the city $2,884,789. In addition to this amount the city owes the company for electric lighting, from the New York Edison system, according to the company's figures, $2,613,821. Current bills, however, for electric energy and lamp maintainance are now being paid. The report said that the most noteworthy feature of the company's year in connection with the operation of its business was the opening of the first unit of the new plant at Astoria on December 3, 1906. This first unit has a capacity of 4,000,000 cubic feet of gas per day, or about one-fifth of what the total capacity will be when the entire plant is completed. It will be several months before one-half the plant is ready for operation, but it is expected that the entire plant will be in working order before the close of the current year.

DIVIDENDS.—The directors of the Binghamton (N. Y.) Light, Heat & Power Company have declared a dividend of 1½ per cent on the common stock, payable January 15, and a regular semi-annual dividend of 3 per cent on the preferred stock, payable January 15. This is the first dividend on the common stock for some time. The directors of the Western Telephone & Telegraph Company have declared the regular semi-annual dividend of $2.50 per share on the preferred stock, payable February 1. The directors of the West Penn. Railways Company have declared the regular quarterly dividend of 1¼ per cent on the preferred stock, payable February 1. The directors of the American Light & Traction Company have declared the regular quarterly dividends of 1½ per cent on the preferred stock and 1¼ per cent on the common stock, payable February 1. The directors of the Helena Light & Railway Company have declared the regular quarterly dividend of 1¼ per cent on the preferred stock, and a dividend of 1 per cent on the common, payable January 31. The directors of the Butte Electric & Power Company have declared the regular quarterly dividend of 1¼ per cent on the preferred stock, payable February 1. The directors of the Omaha Electric Light & Power Company have declared a regular semi-annual dividend of $2.50 on the preferred stock, payable February 1.

WESTERN UNION BONDS.—It is said that the subscription to the issue of Western Union Telegraph $10,000,000 new 4 per cent bonds by the stockholders were disappointingly small, and that the greater part of this amount was taken by the underwriters. The weakness in the stock, which has been conspicuous since the announcement of the bond issue, was probably further accentuated by the report of the quarter ended December 31, 1906, which showed a decrease of $400,000 in net revenue as compared with the same period in 1905, while the surplus after dividends for the quarter was $50,290, against $459,272 in 1905. That the bond issue was not pleasing to the entire body of stockholders is apparent from the number of letters asking explanation of this action received by the management. Many stockholders, it is said, seem to have been unable to grasp the fact that the expenditure of $10,000,000 by the Western Union for improvements and extensions does not mean merely an increase in fixed charges of $400,000 annually, but also a considerable addition to gross earnings, with the possibility of a decrease in operating expenses and a proportionate increase in net earnings.

CHICAGO TELEPHONE COMPANY.—The Chicago Telephone Company in its annual report for 1906 makes the showing below:

Gross revenue	$7,907,567.95
Gross expenses (operation, taxes, maintenance and reserve for deferred maintenance)	6,289,423.57
Net earnings	1,618,144.38
Dividends	1,400,000.00
Surplus for year	$218,144.38

It is stated that at least $6,000,000 should be expended in 1907 in making proper changes and extensions. The company has 162 exchanges (the 15 in Chicago being counted as one) 52 toll stations, 170,834 subscribers, 389 miles of conduit; 248,939 miles of wire underground, 93,031 miles of aerial cable, and 57,016 miles of wire on poles. The gain in subscribers for the year was 27,611.

UTICA LIGHTING MERGER.—It is anounced from Utica that interests identified with the Utica Gas & Electric Company have acquired full ownership of the Herkimer County Light & Power Company, which operates in Dolgeville, Little Falls, Herkimer, Ilion and Mohawk; the Glens Falls Gas & Electric Company, the Consolidated Light & Power Company, of Whitehall, and the United Gas & Electric Company, of Sandy Hill, Fort Edward and South Glens Falls. It is understood that the amount paid for these properties was about $1,500,000. The intention is to merge them into one corporation, which will represent an investment of about $7,000,000. The Utica Company has made a contract with the Union Bag & Paper Company, which owns a big power plant on the Upper Hudson, for 8,000 hp, which it will use to supply Glens Falls, Saratoga and neighboring places, and may enter Amsterdam, Schenectady and Albany.

CARNEGIE TRUST COMPANY.—This new company has opened offices at 111-115 Broadway, with a capital and surplus of $1,500,000 to carry on a regular trust and banking business. Its directorate includes Mr. A. B. Chandler, chairman of the Board of Directors of the Postal Telegraph-Cable Company, and Mr. Anson W. Burchard, of the General Electric Company. Mr. A. E. Chandler, well known in electrical circles, is assistant trust officer of the company.

THE KINGSTON EARTHQUAKE.—The West India Electric Company, which runs the tramway and lighting companies in Kingston, Jamaica, is owned almost entirely in Montreal. It has a capital of $800,000 and $600,000 of bonds. James Hutchison, of the Montreal Stock Exchange, is president. Cable dispatches indicate that the power houses and lighting plants of the company have been entirely destroyed, and that the trolley tracks and system are in bad condition.

NORTHAMPTON DEAL.—The Massachusetts Lighting Company, which controls plants in a dozen or more Massachusetts cities and towns, has purchased a controlling interest in the stock of the Northampton Electric Light Company. It is stated that $275 was paid for each share. Of this $175 is in cash and the other $100 in stock of the Massachusetts Lighting Company.

UNITED STATES TELEPHONE.—The United States Telephone Company of Cleveland reports $33,493 gross for November, and $21,950 net an increase over November, 1905, of $7,218. The fixed charges to be met were $13,517, and after a dividend of $5,000 for the common stock, the surplus was $3,433.

NORTHERN OHIO.—The Northern Ohio Traction & Light Company reports for the past year a surplus of $213,000, an increase of $30,000 over 1905.

GENERAL NEWS.

Construction News.

BIRMINGHAM, ALA.—The Tidewater Development Company has about completed its plans for the construction of an electric freight and passenger railway from Gadsden to Tuscaloosa. The rights of way have been secured throughout the route and franchises secured. J. M. Dewberry is president of the company.

BIRMINGHAM, ALA.—Officials of the Birmingham Railway Light & Power Company have held a conference looking to work on the new power house north of the city on a thirty-acre tract of land. The company is building several new car lines, extending its steam heating mains and building a number of motors and cars in its home shops. The company has appropriated $1,000,000 for improvements this year.

MOBILE, ALA.—Bids will be received until Feb. 4 by the Board of Revenue and Road Commissioners for a complete conduit installation for a low tension system of electric lighting for the new jail building. Rudolph Benz & Sons are the architects.

BERKELEY, CAL.—The Board of Trustees has granted the Oakland Traction Company two franchises to operate lines on a number of crosstown streets. The total amount paid for the franchises was $7,500.

CHICO, CAL.—The Northern Electric Company has asked the City Council for another franchise in this city. The company will soon put into operation a movable sub-station, which is being constructed at the company's carbarns, south of the city. The transformers and other electrical apparatus are being placed upon a large steel car erected for this purpose.

CLAREMONT, CAL.—The Claremont Water Company has been purchased by a local syndicate and incorporated under the name of the Citizens' Light & Power Company. L. N. Smith is president of the company and George Jenks the treasurer. The property consists of a first-class power plant, wells, reservoir and forty acres of watershed located two miles north of town and about fifteen miles of main.

KENNETT, CAL.—The Northern California Power Company is contemplating the construction of a 50-ton experimental electric smelting plant for iron ores, to be located six miles east of Kennett, near the confluence of the McCloud and Pits Rivers.

LOS ANGELES, CAL.—The City Council has passed an ordinance to advertise for sale a franchise for another electric line extension into the Eagle Rock district. The franchise is sought by the Los Angeles Railway Company and extends from the terminus of its Garvanza line.

LOS ANGELES, CAL.—H. H. Clark, a prominent mining man of Nevada, is planning to develop power from the Kings River in the Sierras on the dividing line between California and Nevada, which will mean an expenditure of not less than $6,000,000 in the construction of dams, generating plants and wire lines which will convey electricity to Los Angeles, San Francisco and the various mining camps in Western and Southern Nevada. The site of the proposed plant is near the narrow-gauge road running from Sodaville, Nev., to Keeler, Cal., and controlled by the Southern Pacific.

MERCED, CAL.—Plans are being prepared for the electrification of the Yosemite Valley Railroad, from Merced to the Yosemite.

OAKLAND, CAL.—The Sunset Telephone and Telegraph Company is preparing to make extensive improvements and increase the capacity of its system in Oakland. A reinforced concrete building is to be erected at once at the corner of Telegraph Avenue and Forty-fifth Street at a cost of $40,000.

SAN BERNARDINO, CAL.—The Arrowhead Reservoir & Power Company is to operate its incline in Waterman Canyon by electricity. The power is to be obtained from the Edison Electric Company, which already has a power line in Waterman Canyon as far as the old Waterman barn. From there the Arrowhead Reservoir & Power Company will take it and carry the line up to the foot of the incline, which is at the head of the canyon, just across from the foot of the switchback grade. The tunnel project calls for 335 feet in length, 7x8 feet in size.

SAN FRANCISCO, CAL.—The Stanislaus Electric Power Company, through its working company, the Union Construction Company, has closed a contract for its power house equipment. The site of the proposed plant is at Vallecito, on the Stanislaus River, near Angels Camp, and the scheme contemplates the utilization of the waters of the Stanislaus River, transmitting the power electrically to San Francisco, and incidentally tapping the southern mines and the upper San Joaquin Valley. The present equipment calls for three 6,700-kw 400 r.p.m. General Electric generators, each of which will be driven by a Pelton water wheel unit of 12,000-horsepower capacity. This contract is under the direct supervision of the engineering firm of Sanderson & Porter, New York, N. Y., the complete hydraulic equipment being furnished by the Pelton Water Wheel Company, of San Francisco, and the electrical apparatus by the General Electric Company.

SONORA, CAL.—The Sonora Concrete & Cement Company proposes shortly to ask the City Trustees for a franchise for an electric railway to run from the Sonora depot to the plant at Shaw's Flat, and thence to Columbia. W. H. Johnson is manager of the Sonora Concrete & Cement Company.

FORT COLLINS, COL.—The Northern Colorado Electric Light & Power Company has purchased property south of Fort Collins and will erect on the same a switching station plant, to cost about $25,000.

NEW BRITAIN, CONN.—The Stanley Works has petitioned the Legislature for power to vote an increase in its capital stock and for power to produce, distribute and convey steam electric and other power in Hartford and Litchfield Counties. The company is looking for cheaper power and has been procuring water rights in northern and western parts of the town. L. H. Pease is treasurer.

NEW BRITAIN, CONN.—The Consolidated Railway Company will make extensive improvements to its railway system in this city. Several new extensions will be made and many of the lines will be double-tracked. About $192,000 will be expended on the work in this city by the company.

NEW HAVEN, CONN.—The Consolidated Railway Company is contemplating an expenditure of $2,500,000 on the lines and system leased from the Connecticut Railway & Lighting Company. The company is planning extensive improvements to its system in New Britain and Waterbury.

SOUTH NORWALK, CONN.—The municipal electric lighting and water plant has made a very satisfactory financial showing the past year. It made over 100 per cent more profit than any year of its existence, notwithstanding the low rates for electricity. It has earned $14,000 profits, of which $12,000 has been paid on indebtedness. During the year there has been a large expenditure, the special appropriation of $33,000 made for the purchase and installation of the new Deisel engine, but within the year, all but $4,000 of this appropriation has been paid off. The capacity of the plant has been reached and a further enlargement will be asked for during the year.

WALLINGFORD, CONN.—The H. L. Judd Company is installing an electric generator to operate its plant by electricity.

WATERBURY, CONN.—Extensive improvements have been planned for Waterbury by the Consolidated Railway Company, lessee of the Connecticut Railway & Lighting Company. Every line in the city will be double tracked, new car barns will be erected and a new steam lighting plant may be erected to help out the Bulls Bridge plant, which has not given satisfactory service since it has been in operation. The company has made an appropriation of $592,000 for the work to be done in this city.

WASHINGTON, D. C.—The contract for furnishing and erection of apparatus to completely equip the heating, lighting and power plant for the Capitol and other buildings has been awarded to the Westinghouse Electric & Manufacturing Company, of Pittsburg, Pa., using the Parsons steam turbine, for $533,727. Elliott Woods is superintendent of the U. S. Capitol Building and Grounds.

WASHINGTON, D. C.—Bids will be received until Feb. 25 at the office of Lieut. J. H. Poole, Corps of Engineers, U. S. A., superintendent State, War and Navy Department Building, for renewing portions of heating, lighting and power plant of this building. The work will consist of furnishing and installing three boilers, two elevator pumps, a complete system for heating the water of the present hot water heating system by exhaust and live steam, with all piping, tanks, fittings and auxiliaries, for boilers, pumping system and heating system.

TAMPA, FLA.—Plans have been completed for a 4-story hotel to be erected for the De Soto Hotel Company, in which an electric plant is to be installed. W. L. Parker is manager.

ALBANY, GA.—The report of the superintendent of the municipal electric and water plant submitted to the Mayor shows the earnings to be the largest in the history of the plant, in spite of a reduction of 10 per cent on flat rates and 20 per cent on meter rates, made at the beginning of the year. After paying all expenses of maintenance and operation, installing improvements which cost several thousand dollars, including the extending of the street lighting system through Arcadia, and making provision for further extensions to be made this year, the light and water departments paid into the general treasury the net sum of $10,483. In addition to this the streets of the city and the public buildings were lighted without cost. There are 79 arc lamps in use on the streets.

NEWNAN, GA.—The Water and Light Commissioners have purchased a site for the construction of an electric light plant.

WAYCROSS, GA.—Mayor Knight has recommended that an election be held to vote on issuing bonds for the construction of an electric light plant.

LEWISTON, IDAHO.—E. B. Thomas, vice-president of the Commercial Trust Company of this city has made arrangements for the building of an electric road between this city and Grangeville. Bonds are now being sold.

BLOOMINGTON, ILL.—James Gray has been authorized by the City Council to prepare plans and specifications upon which the bids for the remodeling of the municipal electric light plant shall be based.

PANA, ILL.—The Christian County Telephone Company has purchased the interests of Messrs. Jones & Winters, of Chicago, and will manage the system in the future. The new stockholders are F. J. Eberspacher, Julius Broehl, O. E. Penwell, Louis Schlierbach, F. W. Howell and G. W. Sanders. The company controls the exchanges of Tower Hill, Pana, Stonington, Owaneco, Taylorville and Morrisonville. The capital stock will be increased from $160,000 to $200,000.

CROMWELL, IND.—The Wilmot Telephone system in this place has been sold to J. E. Armstrong, of Leesburg. Mr. Armstrong contemplates many improvements.

FORT WAYNE, IND.—Local press reports state that Owen Ford, of St. Louis, Mo.. will prepare preliminary plans for the proposed municipal electric light plant.

INDIANAPOLIS, IND.—A bill has been introduced in the Legislature to amend the present law so that all contracts or franchises made or granted to public utility companies shall be put before the people for approval and not before the Common Councils.

MUSKOGEE, I. T.—The Muskogee electric light, gas and ice plant has been sold to a syndicate of Oklahoma, Chicago and New York capitalists, a charter having been issued at Guthrie incorporating the new company. D. T. Flynn, of Oklahoma City, is president of the new company, and C. Hiser, also of Oklahoma City, is secretary.

DES MOINES, IA.—It is reported that among contracts yet to be let in connection with the erection of the Fleming Building, at 6th and Walnut Streets, are the following: Elevators, light fixtures, heating, wiring, etc. The contract for heating will include the boilers and engines for the electric generators.

CLAY CENTER, KAN.—E. L. Bell, city engineer, writes that contracts for the city electric light plant have been awarded as follows: To Hodge Electrical & Manufacturing Company, of Kansas City, Mo., for generators, exciters and switchboard; to English Iron Works, Kansas City, Mo., for boilers, and to Buffalo Forge Co., Buffalo, N. Y., for steam engines.

LEXINGTON, KY.—The stockholders of the Lexington & Interurban Railways Company are contemplating increasing the capital stock by $1,000,000. Extensive improvements are to be made in the lines and power house.

LOUISVILLE, KY.—The Louisville Railway Company is preparing plans to extend two car lines to the Riverview Park to be completed in April. The West Broadway line is to be extended a half-mile in order to reach the park over two different routes.

OWENSBORO, KY.—The Cumberland Telephone Company has made arrangements whereby it takes over for a period of five years all country lines of the Home Telephone system, including six exchanges.

COVINGTON, LA.—Application has been made to the town by the Covington Ice & Cold Storage Company for a franchise to erect and run electric light wires through the public thoroughfares of the town.

BIDDEFORD, ME.—L. R. Moore, president of the York Light & Heat Company has applied for permission to issue bonds for refunding its indebtedness and for new construction not to exceed the sum of $250,000 in addition to its present indebtedness.

LEWISTON, ME.—The City Council on Jan. 16 authorized the committee on street lights to purchase and install a dynamo at the city pumping station at a cost not to exceed $2,500.

PARIS, ME.—A petition has been presented to the State Legislature to incorporate the Maine Power Company for the purpose of manufacturing, selling and distributing electricity in the town of Paris. The capital stock is placed at $10,000. The incorporators are: Royal H. Bodwell, Percy V. Hill, E. H. Morrill, Guy P. Gannett and H. B. Young.

CAMBRIDGE, MD.—The Town Commissioners have granted the Dorchester Public Service Corporation, of Cambridge, a franchise to construct an electric light plant in Cambridge. The company agrees to erect a plant, to cost not less than $70,000, and have the same in operation by May 1, 1908.

HAGERSTOWN, MD.—The Hagerstown Electric Railway Company is planning for the construction of an electric railway from Boonsboro to Shepherdstown via Keedysville and Sharpsburg and the Antietam battlefield. The stockholders of the company will shortly increase the capital stock from $200,000 to $1,000,000. The proposed line will be nearly 10 miles in length.

FALL RIVER, MASS.—The new power plant at the Fall River line wharf is completed and in operation. The plant furnishes electrciity for lighting the two piers and the Boston freight house. Later it will furnish light for the entire property of the New York, New Haven & Hartford Railroad Company, in this city.

LOWELL, MASS.—Plans are being prepared for the enlargement of the Perry Street station of the Lowell Electric Light Corporation. Stone & Webster, Boston, are the general managers.

NORTHAMPTON, MASS.—The Massachusetts Lighting Company has purchased a controlling interest in the stock of the Northampton Electric Light Company.

SALEM, MASS.—Plans are being made by the Salem Electric Light Company to extend the boiler house and install two additional boilers. The company recently installed a 1,000-kw reciprocating engine and a 350-hp water tube boiler.

TEMPLETON, MASS.—The electric lighting system of the town is nearly completed and it is expected to have the town lighted by electricity within a short time. Electricity for operating the system will be purchased from the Gardner Electric Light Company at the rate of four cents per kw-hour. The town will charge 15 cents per kw-hour for residential lighting and 12 cents per kw-hour for commercial lighting. On the street lighting system there will be 145 incandescent and three arc lamps.

WALTHAM, MASS.—The plant of the Waltham Gas & Electric Lighting Company was damaged by an explosion on Jan. 19, causing a loss of $10,000.

WAREHAM, MASS.—A movement has been started to have the town lighted by electricity, and it is proposed to have the New Bedford & Onset Street Railway Company furnish the electric energy to operate the system.

WORCESTER, MASS.—The Lowell & Fitchburg Street Railway Company has received authority from the Railroad Commission to increase its capital stock $75,000, the proceeds to be used to take up floating indebtedness and to pay for additions.

ADRIAN, MICH.—The Toledo & Western Railroad Company, of Toledo, Ohio, is contemplating taking over the local system, and it is said that many improvements will be made in the line. Charles F. Franklin, of Sylvania, Ohio, is president and general maanger of the Toledo & Western Railroad Company.

COLDWATER, MICH.—At the annual meeting of the Southern Michigan Telephone Company, held recently, it was decided to increase the capital stock from $500,000 to $1,000,000.

HOUGHTON, MICH.—Application has been made to the City Council for a franchise to install an electric light plant by B. Seller.

JACKSON, MICH.—J. B. Foote, of Jackson, general superintendent Commonwealth Power Company, writes that this company does not contemplate constructing a dam, as previously reported.

NORTHPORT, MICH.—Chris B. Kehl, president Water and Light Committee, writes that bids will be received about February 10 for the construction of water works and an electric light plant, to cost $10,000. W. R. Caldwell, of Traverse City, is engineer.

NORTHFIELD, MINN.—Municipal ownership of telephones was defeated by a vote of 223 to 78 on a proposition to bond the city for $25.000 in order to install a telephone system.

OWATONNA, MINN.—The Owatonna City Council has decided to accept the propositions of the Minneapolis, Rochester & Dubuque Electric Railway Company, and will hold a meeting to legally grant street priviliges and to decide upon the purchase of the twenty-acre site asked for. The electric company has been incorporated and will be capitalized at $5,000,000. Steel rails have been ordered, and General Manager Mason states that construction work will begin about April 1.

ST. PAUL, MINN.—The Aldermen on Jan. 15 passed a resolution ordering all poles and overhead wires removed, except trolley poles and wires, from practically all the streets in the west half of the fourth ward, and also from East Seventh Street, from Broadway to Bradley. The companies owning the wires are given until Sept. 1 to clear the streets.

MAGNOLIA, MISS.—The Mayor and Board of Aldermen have contracted with the Magnolia Electric Light Company to furnish electric street lamps for the ensuing year. The town pays a specified amount for lights and exempts the company from taxation by the municipality.

ST. JOSEPH, MO.—The St. Joseph Railway, Light, Heat & Power Company is contemplating the extension of the Jule Street line to Brockdale. J. H. Van Brunt is general manager.

ST. LOUIS, MO.—The electric plant of the Laclede Gas Light Company was destroyed by fire on Jan. 18, causing a loss of $300,000.

ANACONDA, MONT.—The Anaconda Copper Mining Company is now operating part of its railway system from the power plant at Canon Ferry, ninety miles distant from the city. About 300 hp has been installed; in all about 5,000 hp will be used by the company. It will be about six months before the old system will be superseded by the new. The old plant will be kept in reserve in case of emergency.

KALISPELL, MONT.—The interests of the Tinkels and Conrads in the Big Fork Water Power plant have been taken over by the Flathead Valley Water Power Company. The company is capitalized at $350,000, and financed by the Howard-Shinto Company, of Chicago, Ill. The company will develop a plant of 2,000 hp during the coming season.

OMAHA, NEB.—The Omaha & Council Bluffs Street Railway Company will build an interurban railway between Omaha and Plattsmouth. The new line will be an extension from Fort Crook and will require about 10 miles of trackage. W. A. Smith is general manager.

CARSON, NEV.—James T. Shaw, a prominent mine owner of the mining district of Masonic, Cal., is arranging for the building of a large electric plant in the new mining camp of Mono county. The machinery

has been ordered from San Francisco. The plant will be used to light and to work a number of electric hoists being erected in the district.

RENO, NEV.—It is stated that the Southern Pacific Company is planning to reconstruct its line from Reno to Carlin, a distance of about 250 miles, and run electric trains between the two places, instead of steam locomotives. Engineer Barclay, who has charge of Southern Pacific construction work in Nevada, states that he is making estimates of the cost of the electric project. The railroad company will obtain its power from the Truckee River General Electric Company, which operates four power plants along the banks of the Truckee River between Reno and Floriston.

ATLANTIC CITY, N. J.—Chief Farrand of the electrical department in his annual report to City Council recommends an exclusive franchise to the Atlantic City Electric Light & Power Company, so that the company may place high voltage wires in conduits. He further recommends that the decorative lights along the boardwalk be placed on permanent structures, and that all wires be placed under the boardwalk, at a cost of from $35,000 to $45,000. He also favors the retention of the decorative lights at a cost of about $15,000.

MOUNT HOLLY, N. J.—Harry Hawkins, Jr., township clerk, writes that the contract for lighting streets for five years has been awarded to the Public Service Corporation of New Jersey.

ALBANY, N. Y.—Plans are being made by the United Traction Company to double track its new subsidiary line, the Hudson Valley Railway, and make many other improvements to the line. Edgar S. Fassett is general manager of the road.

BINGHAMTON, N. Y.—The Binghamton Light, Heat & Power Company has recently installed a Curtis steam turbine of 750 hp capacity in its plant.

ELMIRA, N. Y.—Permission has been given to the Elmira, Corning & Waverly Trolley Company to continue its line through the towns of Chemung and Ashland.

GOSHEN, N. Y.—A franchise has been granted to the Goshen Light & Power Company for a term of 25 years. It is reported that a deal has been consummated whereby the local company has been united with the Orange-Rockland Electric Company, which has recently increased its capital stock $50,000 and authorized a bond issue of $5,000. The local plant will be practically rebuilt.

HADLEY, N. Y.—The Hudson River Water Power Company has purchased a large tract of land in the town of Hadley. The consideration was $150,000. The land is being purchased by the company for the development of the territory along the Sacandaga River.

NEW YORK, N. Y.—The bureau of franchises and board of estimate and apportionment have requested the Independent Atlantic Telephone Company, whose application for a New York City franchise has been pending for months, to proceed at once to prepare and submit its detailed plans for a complete city service. A specimen plant will be installed in the police headquarters building for observation.

NIAGARA FALLS, N. Y.—The Council has adopted a resolution, providing for the investigation of the cost of constructing and maintaining a municipal electric light plant.

PEEKSKILL, N. Y.—The State Board of Railroad Commissioners has issued a certificate of necessity to the Putnam & Westchester Traction Company to build an electric road from Peekskill to Oregon, Putnam county, 3¼ miles in length.

PORT HENRY, N. Y.—The State Commission of Gas and Electricity has granted the application of the Port Henry Light, Heat & Power Company for a certificate of authority to furnish electricity for light and power in Port Henry, but reduced the capitalization from $100,000 to $50,000.

POUGHKEEPSIE, N. Y.—The State Commission at Albany has authorized the Poughkeepsie Light, Heat & Power Company to issue $150,000 for improvements.

CHARLOTTE, N. C.—The Westinghouse Electric & Manufacturing Company has received an order from the Southern Power Company, of Charlotte, N. C., for about $500,000 worth of machinery. The machinery will be used in extending the power plants of the Southern Company. The last order calls for apparatus for the Rock Creek and 99-Island power plants, which include 12 4,000-hp water wheel type, electric power generators, and 18 2,500-kw transformers, including switchboard appliances.

CHARLOTTE, N. C.—W. S. Lee, second vice-president and chief engineer of the Southern Power Company, will soon place an order for the water-wheel equipment for the two new plants, one at Rocky Creek and the other at Ninety-Nine Islands, which will cost approximately about $250,000.

WASHINGTON, N. C.—The Washington Investment Company has under consideration the proposition of establishing an electric railway system in this place in the near future.

BATAVIA, OHIO.—In the condemnation proceedings of the Little Miami Heat, Light & Power Company against John T. White and others, Judge Paxton has decided that the law allowing condemnation proceedings on the part of heat, light and power companies is constitutional. The defendants made their stand on the ground of the unconstitutionality of the law. The company wishes to purchase the White property, consisting of five acres, on which to locate a power plant on the Little Miami River. A hearing to determine the damages will be held later on. This company is planning to dam the Little Miami River in several places in order to obtain power to operate its plants.

CLEVELAND, OHIO.—It is reported that the United States Telephone Company has practically closed negotiations for the purchase of the properties of the Interstate Telephone Company, which operates in Western Pennsylvania.

COLUMBUS, OHIO.—Architects are preparing plans for the new substation to be erected by the Columbus Citizens Telephone Company, at the corner of Oak Street and Miller Avenue. The equipment will be automatic, the same as at the central station. The building will cost about $6,000.

COLUMBUS, OHIO.—M. M. Reid, superintendent of the department of lighting, writes that bids will probably be called for in March for one 1,000-kw steam turbine; one 1,000-kw turbine type alternator; one exciter set; one 1,000-kw condenser and auxiliaries; two 300-hp water-tube boilers; stokers for same, and 300 2,000-cp arc lamps, etc. The probable cost is placed at $90,000. According to the December report of Mr. Reid, superintendent of the municipal electric light plant, the plant for that month has a deficit of $4,113.39. The extra expense was due to the breakdown in the machinery, which compelled the city to buy electrical energy from the Columbus Public Service Company. The energy bought came to $7,176.32, of which $5,330.72 has been paid. What the plant still owes on it, $1,945.60, is included in the amount of the deficit. Mr. Reid states if the plant had been in good shape and no electricity purchased there would have been no deficit.

HENRIETTA, OHIO.—The Henrietta Rurual Telephone Company has increased its capital stock from $4,000 to $8,000.

LAKEWOOD, OHIO.—Because of a political row in the village the disposal of the municipal light plant will probably be made by the courts. It is said that Mayor Johnson, of Cleveland, is engineering a deal for the annexation of the village to Cleveland, in order partly to secure another municipal light plant to operate in connection with the one in Newburg.

SPRINGFIELD, OHIO.—Negotiations have been in progress for some time looking toward a merger of the Peoples' Light, Heat & Power Company and the Home Light, Heat & Power Company.

AURORA, ORE.—The plant of the Aurora Electric Light Company has been put out of commission owing to the breaking of the large dam which furnishes the power for operating the plant. The company furnishes electricity for lighting the towns of Aurora, Barlow, Canby and Hubbard, which will be in darkness until the dam can be repaired.

DRAIN, ORE.—C. M. O'Harnett, an electrician of Denver, Col., is reported interested in the construction of an electric light plant in Drain.

PORTLAND, ORE.—The Navy Department has completed plans for a central power plant at the Puget Sound Navy Yard, to cost $308,000.

ALTOONA, PA.—The Altoona & Logans Valley Railway Company is contemplating the building of several branches on its extensions in the vicinity of Hollidaysburg.

EASTON, PA.—The water and light committee will request the City Council for an appropriation of $10,000 for improvements for the municipal electric lighting plant. A dynamo and armature have been ordered, in order to improve the street lighting system as soon as possible. It is reported that an entire plant, to cost $47,500, is under consideration. B. G. Eckard is superintendent.

EASTON, PA.—The Easton Power Company has made an offer to Mayor March to furnish electric lighting to the city while repairs are being made to the muncipal electric light plant. The company offers to furnish 2,000-cp arc lamps until such time as the city is in readiness to operate the municipal plant at its full capacity. Should such an arrangement be made the company asks that it shall be reimbursed for the actual expenditure for the lamps, at the termination of its services, and in addition be paid for the period during which it furnishes light to the city, to be determined by a board of three arbitrators, one to be named by the city, one to be named by the Easton Power Company, and the third to be chosen by the other two thus named.

GREENSBURG, PA.—The Pittsburg, McKeesport & Greensburg Company is contemplating an extension of its present southern terminus from Hunker through Mt. Pleasant to Greensburg by the way of Hecla and Youngwood, and may extend the line to Scottdale, provided the rights of way can be secured.

HARRISBURG, PA.—Judge Kunkel, of the Dauphin County Court, has issued a decree that ends the equity suit of the State instituted by Attorney General Carson against the McCall Ferry Power Company.

HAZLETON, PA.—Governor Pennypacker has refused the application of the Harwood Electric Transmission Company for a perpetual charter to operate in Luzerne, Columbia, Schuylkill, Carbon, Berks, Lehigh and Northumberland counties. The company is capitalized at $5,000 and has headquarters in Philadelphia. It was the announced intention of the applicants to erect their power plant in the Luzerne coal field, and utilize the culm and cheap fuel produced by the Pardee mines to generate current at a low cost and convey it to the counties named. A

charter was granted to the Harwood Electric Power Company, formed by exactly the same persons as the Harwood Transmission Company. The Harwood Electric Power Company is capitalized at $50,000, and will supply electric heat, light and power in Hazleton township, Luzerne county.

LANSFORD, PA.—The new power plant of the Lehigh Coal & Navigation Company is now completed and furnishing electric energy for operating the electric railway system of the Tamaqua & Lansford Electric Street Railway Company. The new plant has more than double the capacity of the old plant and cost $250,000.

McCALL'S FERRY, PA.—Owing to the damage done by the heavy floods work has been suspended for an indefinite period by the McCall's Ferry Water Power Company on the dam which it is constructing on the Susquehanna River.

MEADVILLE, PA.—Chas. B. Reed has been engaged as consulting engineer for the electric light plant and suggests that a plant in connection with the water plant be installed at a cost of about $35,000.

NEW HAVEN, PA.—At a meeting of the New Haven Council, held Jan. 7, the West Penn Electric Company presented its acceptance of the contract for public lighting. The contract is for a term of five years, and provides that the nine arc lamps remain on Main Street, and that the other 11 arc lamps on Main Street to be displaced by 24 Nernst lamps to be located by the Council, the arc lamps to cost $65 per year and the Nernst lamps to cost $24 each per year. The contract also stipulates that the service from Oct. 15 to Dec. 1 be donated free.

PENNSBURG, PA.—The Council has passed on final reading the ordinance providing for the issuance of $15,000 in bonds for the building of an electric light plant for the borough.

PITTSBURG, PA.—The City Council on Jan. 14 passed the resolution authorizing the letting of a two-year contract for lighting the city to the Allegheny County Light Company at $76 per lamp per year, providing for the payment of back bills on the same basis. At the expiration of the two years which date from May 28, 1906, at least two other companies, the Duquesne Light Company and the South Side Manufacturing Company, will be in a position to bid on municipal lighting.

PITTSBURG, PA.—Arrangements are being made by the American Union Telephone Company to commence work on the new Pittsburg-Philadelphia independent telephone trunk line. More than $50,000 worth of material and equipment has been purchased for the new line and for improvements to the systems at Lancaster, Harrisburg, Altoona, Erie and New Castle. A contract has been closed for $75,000 worth of copper wire and 12,000 new telephone instruments have been ordered. Ellis L. Orvis is president of the company.

SAN JUAN, P. R.—The San Juan Light & Transit Company is making many extensions and improvements to its system. The company is building a hydro-electric plant with twenty miles of transmission lines, additional railway lines, reconstructing its old lines, and is building a new sub-station. C. F. Beames is manager.

ANDERSON, S. C.—The Hugh McRae & Company, bankers of Wilmington, have purchased the water power site known as Hatton's Shoals, on Tugaloo River, 14 miles west of Anderson. The property consists of about 600 acres of land and is part in Anderson County, S. C., and part in Hart County, Ga., and includes the rights of way for power lines, the charter, franchises, etc., of the Hatton's Shoals Company. The new owners will develop the power and transmit it to Anderson for manufacturing purposes.

SPARTANBURG, S. C.—The Southern Power Manufacturing Company has applied for a franchise to do business in Spartanburg. The company is engaged in developing water power in this section and will expend about $1,000,000 in developing power plants.

HARTSVILLE, TENN.—R. G. Owen & Son have installed an electric light plant in their tobacco factory here and the citizens of Hartsville are investigating the cost of having the firm supply electric light for the town and residences.

KNOXVILLE, TENN.—In the report submitted to the Mayor and Board of Aldermen by Fillmore Tyson, chief engineer of the Louisville Fire Department, upon the investigation of the Knoxville Fire Department, recommends that the underground wire ordinance should be passed immediately, and the erection of a modern repair shop equipped with necessary machinery, driven by electricity.

ALVIN, TEX.—H. C. Mayer, of San Antonio, has submitted a proposition to this city for the construction of an electric light plant and if same is accepted will install a plant to cost about $19,000.

GALVESTON, TEX.—Improvements that will cost about $20,000 are now being made to the central power house of the Galveston Electric Company. A new boiler of 250-hp capacity is being installed and a motor generator will shortly be installed to be used in case of emergency.

PALESTINE, TEX.—The Palestine Electric Light & Ice Company has awarded a contract for turbine alternators to cost $30,000, two water-tube boilers of 1,000 to 1,200 hp, costing $8,600, concrete stack $2,500 and $25,000 for an ice plant. The company will expend $100,000 on the buildings and machinery.

SALT LAKE CITY, UTAH.—The Utah Light & Railway Company is contemplating the construction of a steam power plant of 25,000 hp, to be located on the Jordan River, between South Temple and First South Streets, at a cost of about $500,000. The appropriation for the construction of the power house has already been authorized, plans have been drawn, and work on the power house will commence at once. A plant of 15,000 hp will be installed at once, with 10,000 to be added as soon as needed.

ALEXANDRIA, VA.—The Alexandria Electric Company has voted to issue $150,000 in bonds for improvements.

NORFOLK, VA.—The Norfolk & Portsmouth Traction Company is contemplating making improvements to its power station and also to the lines of the Norfolk & Atlanta Terminal Road, from this city to the Jamestown Exposition Grounds.

RICHMOND, VA.—At a meeting of the City Council, held Jan. 7, the Virginia Passenger & Power Company submitted a proposition to the joint committees on light, water and electricity. The receivers of the company agree to furnish the city of Richmond electric energy for municipal lighting and for pumping the water supply, as needed, at a price as low as could be produced by the city at the proposed municipal electric plant, in case it should be installed, this cost to be arrived at by a board of three competent and impartial experts, not in any way connected with either party. The contract would be made for any number of years that the city might desire, up to ten.

BREMERTON, WASH.—The Navy Department at Washington, D. C., is reported to have completed plans for a central power plant at the Puget Sound Navy Yard, to cost $308,000. It will be built largely by contract.

ROSALIA, WASH.—The Town Council has granted the Spokane & Inland Empire Railroad Company, of Spokane, a franchise to install and operate an electric light and power plant in Rosalia.

SPOKANE, WASH.—Announcement has been made by the Pacific States Telephone & Telegraph Company that it will expend more than $175,000 in improving its service in Spokane and surrounding towns. Plans have been prepared and it is expected that work will commence soon.

STARBUCK, WASH.—The Starbuck Electric Light & Power Company is preparing to construct an electric light plant in this place at a cost of about $6,000. The company has placed an order with the General Electric Company for a generator of 100-kw capacity. The officers of the company are: Dr. M. Pietrzycki, president, and F. Pietrzycki, secretary.

HINTON, W. VA.—The Hinton Water, Light & Supply Company is considering the remodeling of the water and light plant.

ASHLAND, WIS.—The citizens voted on Jan. 15 in favor of municipal lighting and will install a gas and electric light plant, to cost about $80,000.

HATFIELD, WIS.—We are informed that the La Crosse Power Company will build a dam at Hatfield. W. J. Ferris, of La Crosse, is president.

KILBOURN, WIS.—It is reported that plans are being prepared by Daniel W. Mead for the construction of a hydro-electric power plant in this place for the Southern Wisconsin Power Company, of Madison.

LA CROSSE, WIS.—To provide for its rapidly increasing business the La Crosse Gas & Electric Company is practically doubling its plant. An addition 70x150 feet is being erected. A new 1,000-hp engine and dynamo will be installed.

CHEYENNE, WYO.—R. B. Knott has been awarded the contract for a new electric light plant for the Hammond Packing Company.

CALGARY, CAN.—The Board of Trade has called upon the Council to construct a municipal telephone plant at once. Address Mayor Cameron.

PORTAGE LA PRAIRIE, MAN.—The City Council is considering the purchase of the plant of the Central Electric Company for $50,000, and having it operated by the municipality.

HALIFAX, N. S.—At a recent meeting of the directors of the Halifax & Suburban Electric Company it was decided to build an electric tramway from Halifax through Rockingham and Bedford to Waverly. Among the directors elected are: Hon. William Chisholm, George E. Boak and M. E. Keefe, of Halifax. It is understood that the control of the company has been secured by Harvey E. Harding, of St. John, who, with American associates, will build the road.

OTTAWA, ONT.—The Government has leased the Beauharnois Canal to Messrs. Robert and McIntyre, of Montreal, for power development. The lessees assume the cost of maintenance, $20,000 a year, and must make an immediate expenditure of $60,000, and other outlays from time to time. They will have to pay the Government a rental of $12,000 a year, and will have to supply power to Montreal, Valleyfield, and other municipalities at rates subject to the control of the Government. In this way the municipalities will get cheap power.

Company Elections.

MEDORA, ILL.—At a recent meeting of the Brighton Mutual Telephone Company the following officers were elected for the ensuing year: Charles P. Long, president; John Heyer, vice-president; Miss N. Flanagan, secretary; Dr. John Ash, treasurer, and Walter G. Grant, general manager.

HARMON, ILL.—At the annual meeting of the Green River Telephone Company the following officers were elected: Elmer Cotton, president; William E. Hopkins, vice-president; Benjamin F. Swab, secretary; William H. Kugler, treasurer and general manager.

FALL RIVER, MASS.—At the annual meeting of the Fall River Electric Company the following officers were elected: Albert F. Dow, treasurer; Owen Durfee, clerk. The directors are Edward L. Anthony, George A. Ballard, Rufus W. Bassett, Jerome C. Borden, Ferdinand O. Dodge, John D. Flint, Robert S. Goff, Oliver S. Hawes and James E. Osborn.

NORTHAMPTON, MASS.—At the annual meeting of the Northampton Electric Lighting Company, held Jan. 16, the transfer of the controlling interest of the company was made to the Massachusetts Lighting Company and the following officers were elected: Alfred Clarke, president; Addis M. Whitney, secretary and treasurer, and Clifton B. Day, general manager. The directors are: Arthur E. Childs, of Worcester; Addis M. Whitney, of Boston; C. H. Pierce and C. E. Gould, of Northampton.

SALEM, MASS.—At the annual meeting of the Salem Electric Light Company, held Jan. 16, the following board of directors was chosen: Charles H. Price, president; George M. Harris, Benjamin W. Currier, Arthur S. Temple, George H. Shattuck, Henry P. Benson and Harry M. Batchelder, secretary and treasurer.

ST. PAUL, MINN.—At the annual meeting of the Monson Automatic Telephone Company, held January 14, the following officers were elected: J. M. Anderson, president; Dr. G. P. Sanberg, vice-president; Lars Rosness, secretary. The company will establish a factory in St. Paul.

ST. LOUIS, MO.—At the annual meeting of the stockholders of the Wagner Electric Company, held recently, the following directors were re-elected: S. M. Dodd, Albert Blair, J. C. Van Blarcom, James Campbell, Thomas H. Weest, W. A. Layman and James W. Bell. S. M. Dodd was elected president and Albert Blair secretary. Since the last meeting the company has removed to its new manufacturing plant, near the Wabash Railway tracks on Plymouth Avenue, west of Wellston. S. Mark Dodd, representing the Wagner Electric Co., has presented a petition to the St. Louis County Court, asking for a franchise to string wires for electric lighting along Plymouth Avenue in the vicinity of the plant at Wellston.

NEW MARKET, N. H.—At the annual meeting of the stockholders of the New Market Electric Light, Power & Heat Company, held Jan. 8, the following officers and directors were elected: Fred B. Philbrick, Charles A. Morse, Arioch W. Griffiths, Charles B. Edgerly, Sarah J. Woodman, Leonard R. Philbrick and George E. Smith. The board of directors elected the following officers: Fred B. Philbrick, president; George E. Smith, treasurer.

BERGEN, N. Y.—At the annual meeting of the Bergen Telephone Company, held Jan. 13, the following officers were elected: George R. Fuller, president; George Sands, vice-president; C. M. Beattie, secretary, and C. E. Housel, treasurer.

BUFFALO, N. Y.—At the annual meeting of the Frontier Telephone Company, held Jan. 15, the following officers were elected: Burt G. Hubbell, president; Henry H. Parsons, first vice-president; E. C. Lufkin, second vice-president; Byron L. Moore, treasurer.

JOHNSTOWN, N. Y.—At the annual meeting of the Glen Telephone Company, held recently, the following officers were elected: J. S. G. Edwards, president and general manager; Charles B. Knox, vice-president; Edward S. Parkhurst, secretary, and David A. Hays, treasurer.

UTICA, N. Y.—At the annual meeting of the Utica Telephone Company, held Jan. 17, the following officers were elected: Edgar B. Odell, president; H. F. Miller, vice-president; C. I. Poole, secretary and manager, and W. I. Taber, treasurer.

NEWARK, OHIO.—At the annual meeting of the Newark Telephone Company, held Jan. 15, the following officers were elected: Harry Swisher, president; Charles Spencer, secretary, and Edward Kibler, treasurer.

COLUMBUS, OHIO.—At the annual meeting of the stockholders of the Columbus Edison Company, held recently, George W. Bright, William A. Gill, Emil Kieswetter, John Siebert and Adolph Theobold were elected directors. The officers are: Adolph Theobold, president; John Siebert, vice-president; Emil Kieswetter, secretary and treasurer.

ALLENTOWN, PA.—At the annual meeting of the Lehigh Transit Company, held Jan. 14, the following officers and directors were elected: Col. H. C. Trexler, president; E. M. Young, vice-president; directors: George H. Freaser, Edward B. Smith, Hon. William F. Harrity, Hon. T. L. Johnson, Arthur Newbold, George O. Albright and David Young.

ALLENTOWN, PA.—At the annual meeting of the Slatington Power Company, held Jan. 14, Col. Harry C. Trexler was elected president and Charles N. Wagner vice-president.

Legal.

NEW YORK CONDUITS.—The recent decision of the New York State Court of Appeals, in the suit between the West Side Electric Company and the Consolidated Telegraph & Electric Subway Company, sustains the decision of the lower courts to the effect that the West Side Company has no franchise, and that its action to restrain the Subway Company could not be sustained. It was held that the old Board of Electrical Control had no right to grant such a franchise, and that the franchise power vested in the Board of Aldermen.

PROVISION FOR PRESENTMENT TO TELEGRAPH COMPANY OF CLAIM FOR DAMAGES WITHIN SIXTY DAYS.—A telegraph company, in its contract for the transmission of a message, inserted the following provision: "The company will not be liable for damages or statutory penalties in any case where the claim is not presented within sixty days after the message is filed with the company for transmission." The stipulation is a reasonable one and binding upon the party sending the message and has been upheld by the courts of various jurisdictions. In order to meet the requirement of the provision the notice must contain a statement as to the damages claimed. A mere notice to the company that its employes have been negligent, with the circumstances thereof, is insufficient. Thus, where one who had been damaged by the failure of a telegraph company to deliver a message delivered to its agent, notified the company of the fact and stated that he would expect to be refunded the cost of the message and the expense of telephoning rendered necessary by the company's negligence, the company had a good defense to an action for damages in that the notice contained no claim for damages beyond the two minor items mentioned. Western Union Telegraph Company vs. Moxley, Supreme Court of Arkansas.

WHAT CONSTITUTES FRANCHISE TO TELEGRAPH COMPANY.—RIGHT TO TAX.—The city of Visalia, Cal., enacted an ordinance which purported to grant to the Western Union Telegraph Company the right to use the streets of the city for its poles and wires. The ordinance was duly accepted by the company and the city assessed the telegraph company on its tax books for "a franchise granted." Upon the non-payment of the tax the city was about to levy upon and sell the company's poles and wires to satisfy the assessment. The telegraph company met this step with an action to restrain the sale. It was held that the assessment was invalid for the reason that no franchise had been given. The company had the right to place its poles in the streets of Visalia under an act of Congress of 1866, which granted to it a franchise for erecting its poles along the post roads of the United States and which provided that all highways are post roads. The ordinance in question was a mere exercise of the right to regulate the streets and to prevent the obstruction thereof under the police power. At most it was an attempt to grant what the company already had by virtue of the grant of the Federal Government and could not be considered as giving a franchise which could be taxed. Western Union Telegraph Company vs. City of Visalia, Supreme Court of California.

LIABILITY OF ELECTRIC LIGHT COMPANY WHERE POWER IS TURNED ON THROUGH MISUNDERSTANDING WHILE LINEMAN IS AT WORK.—A lineman in the employ of an electric light and power company, before commencing work of repair on some of the company's wires, requested a telephone operator to telephone to the power house to shut off the power. The operator called up the power house and instructed the man in charge to "shut off the power after ten minutes." The man employed in the power house testified that the message, as he understood it, was to take off the power for ten minutes. He accordingly shut off the power and allowed it to remain off for fifteen minutes. He then turned the current on again and the lineman, being at work on the wires at that time, received the full force of the current which resulted in his death. It was contended in an action to recover damages for the death of the lineman that the defendant company was guilty of negligence in not promulgating such proper and suitable rules for the conduct of its business as would have prevented the turning on of the power while the decedent was working on the lines. It was determined that the defendant was not negligent and, therefore, not liable for damages, it appearing that the accident resulted through a misunderstanding which might have happened even if there had been such rules. Van Alstine vs. Standard Light, Heat & Power Company of Unadilla. New York Supreme Court, Appellate Division.

RIGHT TO RECOVER FOR ELECTRIC POWER FURNISHED UNDER CONTRACT WHERE CONTRACT IS NOT FULLY PERFORMED.—The plaintiff entered into a contract under which he agreed to furnish to the defendant for a period of five years electrical power sufficient for the operation of the defendant's electric railway between Montpelier and Barre, Vt. After living up to the terms of the contract for two years the plaintiff, owing to a shortage of power, was unable to furnish electricity sufficient to run the railway and the runnning of cars was for that reason suspended. Thereafter the defendant notified the plaintiff that, on account of the plaintiff's breach in failing to furnish sufficient power, the contract would be treated as ended and that from that time power would not be accepted nor paid for under the contract. It appeared that the plaintiff's breach was due to the fact that there had been an extraordinary and unforseen drouth. It was held that, although the plaintiff had broken his contract and was, therefore, not entitled to any payment under it, he was not entirely without remedy. He was entitled to a recovery of the reasonable value of the power accepted by the defendant less the amount of damages suffered by the defendant on account of the breach of the contract. One essential of the right to recover in such a case is that the party in default establish to the satisfaction of the jury that he endeavored in good faith to fulfill his contract to the letter. This the plaintiff succeeded in doing, but a judgment in his favor was reversed on other grounds. Viles vs. Barre & Montpelier Traction & Power Company.

NEGLIGENCE OF A PUBLIC UTILITY COMPANY IN ALLOWING DIRT TO REMAIN PILED UP IN PUBLIC STREET.—A gas and electric company having obtained a permit from the city of Council Bluffs, Ia., opened up one of the streets of the city for the purpose of laying pipe. The pipe was placed in the trench but the trench was not entirely filled up and some of the dirt was allowed to remain piled up in the street over night. The company failed to indicate the presence of the obstruction in the street by lights or barriers or to warn travelers in any way. During the night a driver in the employ of the city fire department, was thrown from his wagon and injured upon colliding with the pile of earth, while responding to a fire alarm. It was held that the gas company was not guilty of negligence in digging up and obstructing the street. It is, however, the duty of a public service corporation to warn against or guard an obstruction left in the street overnight and a failure to perform such a duty is negligence. In this instance the gas company was held not liable for the reason that the evidence as to the failure to warn and guard was not conclusive. Stevens vs. Citizens' Gas & Electric Company, Supreme Court of Iowa.

RIGHTS OF CREDITORS OF A CORPORATION AGAINST STOCKHOLDERS WHO HAVE NOT PAID FULL VALUE FOR THEIR STOCK.—Where the organizers of a corporation paid for stock issued to them by conveying land to the corporation, the stock issued having a much greater value than the property conveyed in return, the rule is that a creditor who had notice of the transaction before becoming a creditor cannot compel the stockholders to pay the difference between the par value of the stock and the value of the land conveyed. People who give credit to a corporation in ignorance of the fact that bonus stock has been issued have a right to assume that the capital stock has been paid in. In such a case, if the representation is false, it is fraud upon the creditors and they can compel the delinquent stockholders to make good the representation by paying for their stock. But it has been repeatedly held that, in the absence of statutory provisions, where a corporation issues stock as bonus, or for less than its par value in cash, or for property taken at an overvaluation, the transaction cannot be assailed, and full payment by the stockholders required, by or for the benefit of persons who became creditors before the stock was so issued, or who participated in the transaction, or who afterwards dealt with the corporation and became creditors with knowledge, for in neither of these cases is there any fraud against them. Lea vs. Iron Belt Mercantile Company, Supreme Court of Alabama.

NEW YORK LIGHTING.—On January 18, the Appellate Division of the New York Supreme Court affirmed the decision of Justice Dowling, granting an allotment of space to the Long Acre Electric Light and Power Company in the conduit of the Consolidated Telegraph and Electrical Subway Co. The decision is considered of great importance, so far as the lighting situation in New York City is concerned. Justice Dowling at Special Term granted a peremptory writ of mandamus, requiring the Consolidated Company to permit the Long Acre Company to run three conductors, enclosed in a lead-covered cable, in the former's subway. Alton B. Parker represented the Consolidated Company, while the respondent was represented by Austen G. Fox. Mr. John C. Sheehan, the well-known politician, is believed to be deeply interested in the Long Acre Company, which was recently acquired by the Manhattan Transit Company. As the Long Acre Company is the only company outside of the "lighting combination" with a franchise for furnishing light, the decision is of great public interest. The prevailing opinion was written by Justice Scott. Justices Patterson and Clarke concur. There was a dissenting opinion by Justice Ingraham, with Justice Laughlin concurring. Edgar Van Etten, vice-president of the New York Central Railroad Company, is one of the directors of the Long Acre Company, and will soon become its president. Other directors include William J. Clark, foreign manager of the General Electric Company; William H. Lamprecht, of Cleveland; G. Tracey Rogers, president of the Binghamton Railway Company; William Harris and John C. Sheehan.

VALIDITY OF CONTRACT FOR SERVICES OF ELECTRIC INSPECTION COMPANY UNDER THE STATUTE OF FRAUDS.—An electric company engaged in the business of inspecting and repairing electrical apparatus, sent one of its usual contracts for services to a brewing company at the request of the latter. The contract covered services to be performed by the electric company for one year from its date and provided for its renewal for another year in the absence of a notice to terminate from either party within the year. The brewing company sent its check in payment for one year's services in advance, the same being enclosed in a letter signed in the name of the company. At the end of the year, no notice to terminate having been given, the electric company continued to render services under the contract. In an action to recover the annual compensation for the second year the brewing company set up the statute of frauds as a defense, claiming that it had not signed the contract as required by the statute, and that the agreement was void under the statute for the reason that it could not be performed within one year. It was held that the contract was evidenced not alone by the paper signed by the electric company, but also by the brewing company's letter of acceptance, and that these were sufficient to save the agreement from the operation of the statute of frauds. It was further held that the contract was not one which was impossible of performance within one year. The mere fact that the contract provided for a renewal beyond one year, in the absence of notice to terminate, did not make it impossible of performance within the year. It was, therefore, not necessary that the contract be evidenced by any writing whatever. It was held that the electric company was entitled to recover payment for its services in advance for the new year. General Electric Inspection Company vs. Ebling Brewing Company, New York Supreme Court, Appellate Term.

Obituary.

MR. S. E. WILLIAMS, manager of the Jacksonville, Fla., Electric Company, died on January 14, after a sharp attack of typhoid. Mr. Williams was born at Eastchester, N. Y., and was 31 years of age. He was a graduate of Harvard University, and after leaving the college went into the office of Stone & Webster at Boston, where he remained for about two years, being transferred to Dallas, Tex., where he became the assistant manager of the Dallas street railway. In addition to Mr. Williams' connection with the Stone & Webster street car syndicate, he was the secretary of the Rapid Transit Street Railway Company of Dallas, Tex. He leaves a father in New York, a brother, Mr. Drage Williams, and a sister, Mrs. G. L. Robinson, of New York.

Personal.

MR. F. N. BUSHNELL has tendered his resignation as chief engineer of the Rhode Island Company and the Narragansett Electric Lighting Company, to join the staff of Stone & Webster, Boston.

MR. R. H. GAMWELL, who has for the past two years been general manager of the Greensboro Electric Company's properties, in Greensboro, N. C., has resigned his position to accept a position elsewhere.

MR. E. F. SCHNUCK has resigned as general superintendent of Arbuckle Bros., Brooklyn, to become a "production engineer" and a director in the firm of Jabez Burns & Sons, 542 Greenwich Street, New York City.

MR. W. S. CONE, formerly in charge of the new Kern River plant of the Edison Electric Company, of Los Angeles, Cal., has been appointed general manager of the Mt. Whitney Power Company, with headquarters at Visalia, Cal.

MR. E. L. BROOME, steam engineer of the New York Central & Hudson River Railroad Company, has resigned to join the forces of the Stone & Webster Engineering Corporation of Boston, Mass. He will be succeeded by Mr. W. C. Miller, Jr., formerly assistant steam engineer.

MR. WILLIAM H. EASTON, late sales manager of the Heany Fire Proof Wire Company, has accepted the position of manager of the Coal Securities Company, of Scranton, Pa. Mr. Easton was manager of the wire department of the Teter-Heany Development Company during the time this company was in the wire business.

MR. B. K. HOUGH, recently connected with Ford, Bacon & Davis and the New York Edison Company, and some time chief sales engineer of the Stanley Electric Manufacturing Company, has returned to Boston to the Edison Electric Illuminating Company of that city. He was with the Boston Electric Light Company, a constituent company, shortly after his graduation from Cornell in 1897, and before his connection with Stone & Webster.

MR. C. H. BOYNTON.—Mr. Charles H. Boynton, general superintendent of the Eastern Division of the Associated Press, has resigned to become manager of the banking and brokerage firm of Eugene Meyer, Jr., & Company. Mr. Charles T. Thompson, chief of the Associated Press, London bureau, has been recalled to this country to assume the superintendency of the Eastern Division. Pending his arrival, Mr. J. R. Kennedy will assume Mr. Boynton's duties. Mr. Charles E. Kloeber has been appointed news editor in the New York office. Mr. Robert M. Collins will supersede Mr. Thompson in charge of the London office.

MR. F. R. SLATER, consulting electrical engineer, has formed a partnership with Mr. H. N. Latey, under the firm name of Latey & Slater, for the general practice of engineering, with offices at 100 Broadway, New York. Both Mr. Latey and Mr. Slater have been closely identified with the electrical work on the New York subway, Mr. Latey having been principal assistant engineer on the electrical equipment of the subway during construction and for the past three years electrical engineer of the Interborough Rapid Transit Company, while Mr. Slater was assistant engineer in charge of the construction of the direct-current distribution system and later principal assistant engineer, succeeding Mr. Latey. Both gentlemen are eminently qualified by education, training and experience to undertake and execute important work.

GEN. F. V. GREENE, of Buffalo, in an address before the Empire Club of Toronto, Can., discussed the subject of Niagara power. He said that on the American side public opinion seemed to have crystallized into the sentiment of "Save the Falls." On the Canadian side the only sentiment heard was "Transmit and deliver the power at the lowest possible price." In Ontario there was undoubtedly, however, as much feeling in favor of preserving the Falls as there was in the United States, but from better knowledge of the facts there was less apprehension of danger. The International Waterways Commission had pronounced that to destroy the Falls would be a crime, and legislation had strictly limited the amount of water that could be taken, so that those best posted believed that power development would show no change in the appearance of the cataract. He discussed in hopeful terms the utilization of the great cataract without marring its beauty.

Trade Publications.

STRAIGHT AIR BRAKE EQUIPMENTS.—Bulletin No. T-2001 of the Westinghouse Traction Brake Company, Pittsburg, Pa., gives an excellent discussion of straight air brake equipments for electric cars.

ELECTRIC DRIVE.—The Allis-Chalmers Company, Milwaukee, Wis., has issued as bulletin No. 1055 a reprint of an article in the ELECTRICAL WORLD describing the electric drive in the mill of the Dempsey Company, at Tacoma, Wash.

CATALOGUES WANTED.—Mr. H. F. Frasse, purchasing agent of the Edison Electric Company, of Brooklyn, N. Y., requests manufacturers to mail their latest catalogues to 360 Pearl Street, that city, for the files of the purchasing department. The company uses a large amount of supplies and material in the course of the year.

THE ONTARIO POWER COMPANY, of Niagara Falls, has just issued a most interesting portfolio of maps of its power districts. There are five of these maps given in excellent detail and fullness, covering the territory from Syracuse, N. Y., to Hamilton, Ont., the Welland Canal, the Niagara frontier, Buffalo, Depew, etc.

STURTEVANT ENGINES.—The B. F. Sturtevant Co., of Boston, Mass., has just issued a couple of very interesting bulletins, No. 141 and No. 142, descriptive respectively of its vertical enclosed compound engines and of its generating sets equipped with these engines. These sets, which were originally designed to fill the rigid specifications of the U. S. Navy Department, are built in a line of sizes ranging from 17½ to 100 kw.

MOORE LIGHTING SYSTEM.—The Newark, N. J., *Star*, of Jan. 7, devotes a whole page to an illustrated article on the subject of the vacuum tube lighting system of Mr. D. McF. Moore. The article goes into details of his early and present work and is illustrated with views of the apparatus and of stores and buildings in which the Moore light tubes have been installed. At the present time the system is in use in a large number of places and over a mile of tube has been put up.

THE TELHARMONIUM.—The New York Electric Music Company and the Eastern Cahill Telharmonic Company have issued three very interesting and effective pamphlets respecting the scientific, popular and financial aspects of the Cahill plant that has been installed at Thirty-ninth Street and Broadway, New York City, and which is now furnishing music to the concert hall on the spot and to various distributive points. These pamphlets were prepared for these companies by Miss C. Beckwith, of the Manhattan Bureau of Publicity, and are not only good "trade literature," but are of historical value as being the first publications of the kind, devoted to the new art. One of the brochures is handsomely illustrated with views of the plant.

News of the Trade.

THE UNITED STATES CARBON COMPANY on Jan. 17 suffered the loss by fire of its building at 465 Greenwich Street, New York. It has arranged to open new offices at once at 124 West 42d Street.

INCREASING CAPITAL.—At a recent meeting of the stockholders of the Emerson Electric Manufacturing Company, St. Louis, Mo., it was decided to increase the capital stock of the company from $300,000 to $600,000.

THE BUCKEYE ELECTRIC COMPANY has made arrangements with the Pettingel-Andrews Company of Boston to act as its agent and distributor for the Buckeye Class A lamp and the new Buckeye gem lamps.

THE BARSTOW STAFF.—In order to meet the demands of their rapidly extending business, W. S. Barstow & Co., of New York and Portland, Ore., have recently enlarged their power plant department. At the head of the department is Mr. Perry West, who, graduating from the State College of Kentucky, Lexington, with the degree of M. E., became general equipment engineer to Joseph Williams & Co., of Louisville, Ky., a firm identified with some of the most important engineering projects in the country. Subsequently, he joined the forces of Pattison Bros., and was actively engaged in steam turbine work. Recently he has been with the New York Edison Company, in association with Mr. George A. Orrok, chief mechanical engineer of the company, resigning his charge to take office with Barstow & Company. Associated with him is Carl F. Schreiber, who is an M. E. of Columbia University. Mr. Schreiber is favorably known for his work in the testing department of the Brooklyn Rapid Transit Company, and in the steam department of the New York Central & Hudson River Railroad; he was also one of the engineers of the Electric Traction Commission. Later Mr. Schreiber worked in conjunction with Mr. George T. Hanchett, consulting engineer. Another notable addition to the staff is Mr. Rulof Klein, whose appointment may be taken to indicate the wide scope intended for the department. Graduating from the Delft Technical University, Holland, Mr. Klein entered on the field of gas engineering, which has now assumed such importance, and as a gas engine expert he became a member of the "Verein Deutsche Ingenieure." Among other charges in this country, Mr. Klein acted as designing and constructing engineer in the gas engine department of the Wellman, Seaver, Morgan Co., of Cleveland, O. Mr. Klein has just returned from Europe after making a tour of inspection of gas engine power plants in Germany and Belgium. Mr. Klein is a member of the Royal Institute of Dutch Engineers.

Weekly Record of Electrical Patents.

UNITED STATES PATENTS ISSUED JAN. 15, 1907.

[Conducted by Rosenbaum & Stockbridge, Pat. Attys., 140 Nassau St., N. Y.]

841,102. PROCESS OF TREATING ORES; Charles E. Baker and Arthur W. Burwell, Cleveland, O. App. filed July 5, 1904. The process which consists in subjecting pulverulent sulfid ores of metals forming fusible chlorids to the action of sulfur chlorid, thereby producing the chlorid of the metal, fusing said chlorid and recovering the metal.

841,103. PROCESS OF TREATING ORES; Charles E. Baker and Arthur W. Burwell, Cleveland, O. App. filed Mar. 1, 1905. The process which consists in reacting with dry sulfur chlorid upon dry pulverulent sulfid ore, at a suitable temperature, thereby separating sulfur and producing the chlorid of the metal or metals of the ore.

841,105. RECORDING-SIGNAL TRANSMITTER; Rollin A. Baldwin, New Haven, Conn. App. filed Nov. 10, 1905. Relates to signals for single track trolley roads in which a plurality of cars are frequently run in one direction over a block before permitting a plurality of cars to pass in the other direction. The signals are transmitted by a device which makes a record of the number of cars so as to prevent a clear signal being shown until all of the cars have left the block.

841,106. ELECTRIC REGULATOR; Joseph Bijur, New York, N. Y. App. filed Feb. 9, 1905. A pair of resistances having segments which may be engaged by rocking levers so as to simultaneously change the resistance of separate circuits.

841,168. ANNUNCIATOR FOR HOTEL LETTER BOXES; Frederick Muschenheim, New York, N. Y. App. filed Sept. 8, 1906. A plan for notifying the patrons of a hotel that there is mail for them in the hotel post-office. Has an annunciator arrangement automatically actuated by the insertion of the letters.

841,186. ALARM SIGNAL FOR BOILERS; Hermann Sandvoss, Neuss, Germany. App. filed Feb. 23, 1906. A steam gage contains two thermometers, one normally below the water level and the other normally above. In case of undue rise or fall of the level, the changing temperatures produce alarm signals.

841,188. DEVICE FOR DETECTING SUBTERRANEAN WATERS; Adolf Schmid, Berne, Switzerland. App. filed Oct. 14, 1904. An electric alarm system including an incomplete circuit and magnetic needle and a condenser, which are adapted to have different electrical properties under different conditions of atmospheric humidity.

841,215. ELECTRIC REGULATOR; William S. Andrews, Schenectady, N. Y. App. filed June 5, 1902. A metallic ribbon is tightly stretched so as to vibrate in proximity to the pole of an electromagnet which is included in the circuit of a generator in such a way as to produce an intermittent increase of current flow in the field winding thereof, depending on the degree of energization of said magnet.

841,232. ELECTRIC RHEOSTAT; William F. Dana and Henderson W. Knott, New York, N. Y. App. filed July 26, 1905. A resistance element including a plurality of carbon buttons which are assembled on a rod and included between metallic collars so as to keep them in alignment.

841,233. TELEPHONE SYSTEM; William W. Dean, Chicago, Ill. App. filed Jan. 23, 1904. Relates to a diagram for the cord circuits of a central telephone exchange system.

841,234. ROTARY SWITCH; Frank C. DeReamer, Schenectady, N. Y. App. filed July 21, 1904. A snap switch enclosed in a box and adapted to be inserted in a wall or floor so as to be flush with the surface thereof. Provides adjustable means whereby the thumbpiece will visually indicate the position of the movable contact relative to the stationary contact.

841,244. LISTENING APPARATUS FOR TELEPHONES; William W. Grigsby, Lawhon, La. App. filed June 12, 1906. In listening apparatus for telephone exchanges, a movable-contact carrier, contacts arranged to be successively engaged thereby and connected in circuits that are inductively related to the telephone-line, means for imparting a step-by-step movement to the movable-contact carrier, and a telephone-receiver electrically connected to the movable contacts.

841,257. CONTROL OF ALTERNATING-CURRENT MOTORS; Marius C. A. Latour, Paris, France. App. filed Nov. 9, 1905. In combination with a compensated series motor for alternating currents, a local circuit comprising the motor-armature and a source of voltage of proper phase for producing in said local circuit a current for producing a commutating field.

841,270. ELECTRIC MOTOR-DRIVE; William B. Potter, Schenectady, N. Y. App. filed Mar. 21, 1904. In combination, a shunt-motor, a member driven thereby, and a differential booster driven by said motor having its shunt field connected directly in shunt to its armature and adapted to raise the voltage impressed on said motor up to a certain limit as the load on said motor increases.

841,292. TELEPHONE SYSTEM; Alfred H. Weiss, Evanston, Ill. App. filed Sept. 3, 1904. Detail features of cord circuits of a telephone system.

841,305. WINDING MACHINE; George F. Atwood, New York, N. Y. App. filed Apr. 27, 1904. A winding machine for making closed coil windings of transformers, etc. The wire is guided through the iron ring by rollers which are operated by an endless chain deflected past the iron ring by idlers.

841,307. ELECTRIC ANNUNCIATOR; Charles C. Blake, Brookline, Mass. App. filed Nov. 29, 1905. An improvement in annunciators of that class having a signal which moves in an opaque liquid toward and from a window pane. The improvement consists in the ar-

rangement by which the liquid is prevented from escaping into the magnet coils.

841,318. GOVERNOR; Spottswood C. Foster, Fredericksburg, Va. App. filed Sept. 4, 1906. A regulator for a water wheel including a centrifugal governor which moves a cone friction device so as to change the speed relation between two differential members and cause rotation of the stationary part of the differential.

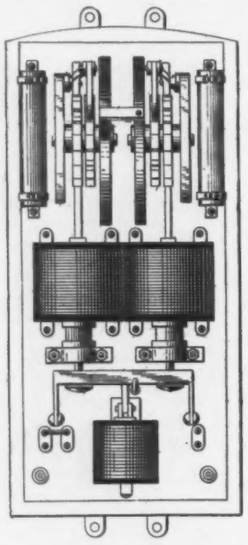
841,335. ADDING MACHINE ATTACHMENT; Frank R. McBerty, Evanston, Ill. App. filed Feb. 24, 1906. The motor drives a gear which has a number of cam wheels thereon which close dinerent circuits in a special way to stop and to apply a magnetic brake to the motor.

841,339. INCOMING TRUNK-LINE; Howard M. Post, Chicago, Ill. App. filed Mar. 14, 1906. Details of circuits for central exchange switchboard for a trunking exchange having A boards and B boards.

841,386. WIRELESS TELEGRAPHY; Lee De Forest, New York, N. Y. App. filed Aug. 27, 1906. An electrical-oscillation-selecting device comprising a vessel inclosing a gaseous medium maintained in a condition of molecular activity, two electrodes inclosed within said vessel, and means for varying the separation of said electrodes.

841,387. DEVICE FOR AMPLIFYING FEEBLE ELECTRICAL CURRENTS· Lee De Forest, New York, N. Y. App. filed Oct. 25, 1906. In a device for amplifying electrical currents, an evacuated vessel, two electrodes sealed within said vessel, means for heating one of said electrodes, a local receiving-circuit associated with said electrodes, and means whereby the separation of said electrodes may be varied by the currents to be amplified.

841,397. TROLLEY HEAD; Otto Hoffman, Berlin, Germany. App. filed Aug. 22, 1905. The trolley harp has a pair of guard plates with projecting cheeks to close over the trolley wire. The guard plates are freely removable when desired.



841,105.—Recording Signal Transmitter.

841,399. COMPOUND TELEPHONE; Carl G. F. Holmgren and August E. Brahm, Stockholm, Sweden. App. filed Aug. 24, 1906. The combination with a compound telephone comprising a receiver, a microphone, and a handle bar connecting the receiver and the microphone, of an imperforate cover in front of the diaphragm of the microphone and a flange extending from the said cover beyond openings provided in the side walls of the chamber between the cover and the diaphragm of the microphone.

841,407. ELECTRICAL SWITCH; John A. Kennedy-McGregor, Birmingham, and Harry Wren, Bexhill, England. App. filed Aug. 18, 1905. The knife blade of the switch has a spring connected handle by which it is moved, and a detent prevents movement of the switch arm until after a predetermined throw of the handle.

841,438. ELECTROMAGNETIC APPARATUS; Armin H. Pickler, Montclair, N J. App. filed April 30, 1906. Elastic connections are interposed between the brackets and clamping frames which hold the windings to the core.

841,449. FUSE BOX; Charles A. Rolfe, Chicago, Ill. App. filed Jan. 21, 1903. The box has a central stationary post which receives the screw for holding on the cover, and this post co-operates with additional lugs of the box to hold the fuses in place.

841,451. RAILWAY BLOCK SYSTEM; William L. Rummel, South Sioux City, Neb. App. filed Aug. 16, 1905. A signal system making use of mechanical tappets along the roadway which are actuated by a passing train to electrically set train stops in the path of a following train.

841,467. TROLLEY; Joseph Tetlow, Saco, Me. App. filed Jan. 19, 1906. The trolley wheel is made in two parts so as to permit the insertion of a ring constituting a removable tread for the wheel.

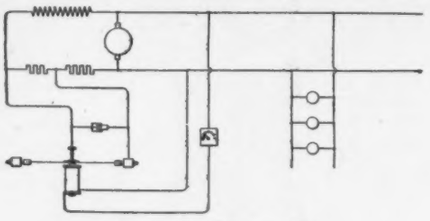
841,476. ELECTRICAL CALLING APPARATUS FOR TELEPHONE; Charles Adams Randall, New York, N. Y. App. filed Dec. 22, 1903. In a telephone calling apparatus, two independent local circuits, one of said local circuits including an electromagnet, a resilient vibrator actuated by said electromagnet to make and break said local circuits alternately, and an induction coil having its primary connected in the local circuit not including the electromagnet and having its secondary connected to line.

841,478. SECRET SERVICE TELEPHONE SYSTEM; Albert K. Andriano, San Francisco, Cal. App. filed Aug. 30, 1901. An intercommunication telephone system having party lines for the different talking circuits between the several stations.

841,497. AUTOMATIC TROLLEY BASE; Hugh W. Fellows, Cahuenga, and Ira A. Cammett, Hollywood, Cal. App. filed Nov. 23, 1905. The trolley pole is pressed upward by a specially constructed spring arrangement with a detent which allows the pole to fall in case it leaves the wire by a sudden upward movement.

841,491. TELEPHONE; Fred Edwards, Jefferson, Ia. App. filed May 9, 1905. In a telephone having an independent transmitting circuit, the combination of a switch in said circuit automatically cut in when the receiver lever is at its lower limit of movement and capable of being manually cut out when the receiver lever is in its elevated position.

841,543. DYNAMO ELECTRIC MACHINE; Marius C. A. Latour, Paris,



841,215.—Electric Regulator.

France. App. filed Jan. 21, 1905. In a dynamo electric machine, a slotted armature core provided with a commutator, two armature windings carried in said slots at equal distances from the periphery of the armature core and differing from each other in the slot pitch of their coils, and connections from said windings to alternate commutator segments.

841,544. ALTERNATING CURRENT MOTOR; Marius C. A. Latour, Paris, France. App. filed Aug. 25, 1905. A method of winding armatures by which the leads of the coils to successive commutator segments are so connected that the phase of the induced voltage at each lead corresponds to the angular position of the commutator segment to which it is connected.

841,545. DYNAMO ELECTRIC MACHINE; Marius C. A. Latour, Paris, France. App. filed June 29, 1906. Relates to modifications of the above.

841,557. AUTOMATIC ELECTRIC FIRE ALARM; William G. Meddings, Remuera, near Auckland, New Zealand. App. filed Mar. 6, 1906. A thermostat adapted to depend from the ceiling at convenient points of a room. Has a fusible bar which resists movement of a spring impelled plunger which normally restrains a blade spring against circuit closing movement.

841,572. PROCESS OF PREPARING CARBON FOR ELECTRICAL RESISTANCES; Edward G. Rivers, Richmond, England. App. filed Dec. 22, 1905. An electrical resistance material consisting of hardened powdered carbon and an alkaline silicious agglutinate.

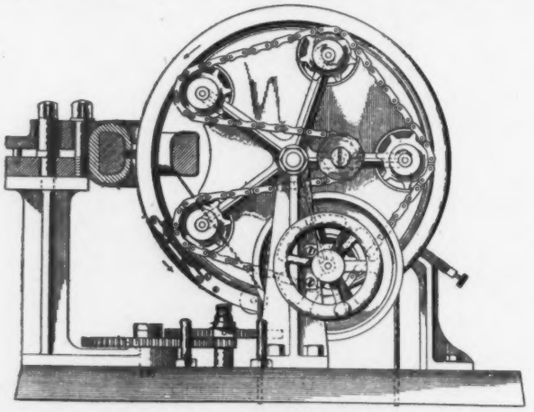
841,583. MARINE ELECTRIC WHARFAGE; George G. Schroeder, Washington, D. C. App. filed Feb. 28, 1905. A plan of unloading vessels at rivers and points where a wharf cannot be built. Employs an elevated telpherage system controllable from the station on the bank which runs out to the ship and carries the articles inward therefrom.

841,599. COMBINED DYNAMO MAGNETO IGNITION DEVICE; Joshua A. Struthers, Youngstown, O. App. filed Aug. 10, 1906. In order to avoid excessive potential from a dynamo driven by an engine for ignition purposes, the patentee has a cut-out magnet which cuts the field coil out of the circuit when a certain potential is reached.

841,607. RAILWAY SIGNALING MECHANISM; Edwin J. Adams, Waco, Tex. App. filed May 3, 1906. A complete block signal system having a special track rail to complete circuits to the locomotive cab and by which alarm signals are displayed on the engine in case a semaphore at danger is passed.

841,609. MOTOR-WINDING; Ernst F. W. Alexanderson, Schenectady, N. Y. App. filed July 23, 1903. A phase winding for a multispeed alternating current motor, having its conductors connected so as to form a plurality of groups in a plurality of which the direction of current flow is the same for a plurality of speeds for the motor, and means for changing the relative connection of the several groups for the different speeds.

841,610. ALTERNATING-CURRENT MOTOR; Ernst F. W. Alexanderson, Schenectady, N. Y. App. filed Nov. 9, 1905. In a dynamo electric machine, a distributed winding having a number of coils in



841,305.—Winding Machine.

a phase which, divided by the number of poles gives a quotient having a remainder, the coils forming the remainder being distributed among a portion of said poles and all the coils being connected to circuit.

841,640. METHOD OF HARMONIC SELECTIVE SIGNALING; Wm. W. Dean, Elyria, O. App. filed Aug. 9, 1905. Shows a specially constructed bell for telephone apparatus which is adapted to ring for currents of a certain periodicity but not for currents of different periodicity.

12,595. ALTERNATING-CURRENT MOTOR; Robert Lundell, New York, N. Y. App. filed Sept. 29, 1906. Reissue of Patent 782,863. Feb. 21, 1905.